

THE RELATIONSHIP BETWEEN ENVIRONMENTAL EDUCATION AND
SCIENCE EDUCATION IN THE SOUTH AFRICAN CONTEXT

By

SALESH PANDAY

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SUPERVISOR: PROF C P LOUBSER

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DECLARATION

I declare that

**THE RELATIONSHIP BETWEEN ENVIRONMENTAL EDUCATION AND SCIENCE EDUCATION
IN THE SOUTH AFRICAN CONTEXT**

is my own work and that all the sources I have used or quoted, have been indicated and acknowledged by means of complete references.

ABSTRACT

The purpose of this research was to investigate the role that science education can play both in facilitating and in enhancing the delivery of environmental education at South African schools. The theoretical links between science education and environmental education were examined. This was followed by a practical investigation which involves the researcher conducting interviews with educators of natural science in order to determine their perspectives on the relationship between science education and environmental education. The results of the research indicate that science education has tremendous potential for incorporating and enhancing the delivery of environmental education. However, this potential is not being fully realised due to a number of limiting factors. It is, therefore, imperative that the education authorities take immediate action to rectify this situation so that the synergy between science education and environmental education comes to fruition.

Key words:

Environment, Environmental Education, Science, Science Education, Sustainability, Science process skills, Science teaching strategies, Environmental literacy, The National Environmental Education Project, Teacher training

TO VERONICA, KIRTHAN AND PAVAN

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CHAPTER ONE

SETTING THE SCENE

1.1 Introduction

Environmental education (EE) has evolved to becoming an integral component of a holistic education which is necessary for the future sustainability of the earth and its variety of life forms. Arms (1994:518), refers to EE as probably being the most important step that needs to be taken on the road towards ensuring a sustainable world. The value of environmental education lies in its ability to eradicate ignorance and apathy and also to pave the way for facilitating international co-operation with regard to the future sustainability of the earth and its limited resources. Thus, the future sustainability of the earth rests firmly in the hands of its people, who can no longer afford to be motivated by self-interest (McCullum 1994:1).

Clark (1991) uses the word 'overkill' to describe the human actions which are motivated by self-interest. 'Overkill' refers to the human compulsion that drives most people to take far more from the environment than they actually need, whenever they are provided with the opportunity to do so. Human demand for the natural resources is outstripping the earth's ability to supply and regenerate itself (Chenje 1999:22). Human actions motivated by self-interest, result in the continuous exploitation of the earth's limited resources, causing serious environmental problems which affect the earth's sustainability. Some of these problems include soil erosion, pollution, the depletion of marine - and other natural resources, overpopulation and the resultant demand for housing, as well as the shortage of food, disease, urbanisation, illiteracy, inadequate water supply, demand for energy and poverty (Clark 1991:3-14).

Humans have become a formidable threat to the earth and human activities have resulted in creating a crisis in the environment (Loubser 1996:5). This crisis is further exacerbated by our modern way of life, resulting in incorrect attitudes towards the environment. These attitudes manifest themselves in the form of greed or what Clark (1991) calls 'overkill', materialism, individualism, developmentalism and industrialisation, resulting in the unsustainable use of the earth's resources (Rhodes University Certificate/Goldfields Preparatory Course In EE. Core Text Theme 1 s.a.: 6).

Dreyer (1996:9) maintains that a change in human attitudes towards the environment is the only long-term solution to ensuring the survival of mankind and the earth. Therefore, people's knowledge of and insight into the environment will have to improve drastically. People need to be educated on how to act positively in their relationship with the environment, in order to ensure its future sustainability (Loubser 1996:5).

In this regard, Dreyer (1996:9-11) highlights the need for people to empower themselves through learning skills, in order to be able to solve problems, prevent the escalation thereof and to develop new values which facilitate the establishment of a new environmental ethos.

Such an environmental ethos requires sufficient education to create an awareness of environmental concerns. Education also provides learners with the necessary knowledge and skills that can empower them to take action and to become active participants in the creation of a sustainable world, thereby enhancing the quality of their own lives and their natural environment (Fien & Gough 1996:200).

Science education (SE) could contribute towards the establishment of such an environmental ethos. Valanides (1996:99) views science education as a way of thinking and as an approach to acquiring new knowledge through developing thinking skills and reasoning abilities. Thus, when faced with environmental concerns which could affect the future sustainability of our world, learners need to be encouraged to think and work scientifically. This can be achieved through the teaching of science process skills, encouraging the development of learners within an investigative framework, thereby enhancing their reasoning abilities and promoting scientific literacy (Arena 1996:34; Matheis et al 1992:211). By applying their scientific knowledge and skills to address environmental concerns and problems, learners become increasingly aware of these problems and would, henceforth, be able to analyse these with a view to finding possible and lasting solutions (Arms 1994:5).

This is necessary in order to ensure that future generations grow up environmentally literate and aware of the impact that humans have on their environment, so that we can collectively act to reverse our present destructive influences, thereby promoting the future sustainability of the earth (Tema 1999: 222-223).

1.2 The purpose of this research

In South African schools, the Outcomes Based Education (OBE) curriculum in the senior phase of the General Education and Training (GET) band, comprises eight learning areas. Unfortunately, environmental education does not exist as an independent learning area within this curriculum. The purpose of this research, therefore, is to analyse and evaluate the extent to which environmental education can be incorporated in science education (the of Natural Science Learning Area (NS)), thereby enhancing the teaching of environmental education in South African schools.

The departure point of this study is that the environmental concerns that education needs to address are fundamental and far-reaching (Department of Education 2001:2). As scientists, we are concerned about the future survival of the earth and its inhabitants. As educators, we have the responsibility of educating tomorrow's leaders. It is, therefore, necessary for us to become proactive and to develop sustainable programs and curriculum initiatives that provide a basis for sensitising learners to their environment, in order to assure the future sustainability of the earth..

Gro Harlem Brundtland, (the Prime Minister of Norway), who in 1987 chaired The World Commission on Environment and Development, defined sustainability as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' (McCullum 1994:1). Globally, EE has assumed the responsibility of facilitating the transformation needed to move towards sustainable living (Chenje 1999:22). This is illustrated by the following principles for EE that emerged from the 1977 UNESCO Conference in Tblisi:

- To foster clear awareness of and concern about economic, social, political and ecological inter-dependence in urban and rural areas.
- To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment.
- To create new patterns of behaviour of individuals, groups and society as a whole towards the environment (Chenje 1999 22).

This research, therefore, proposes to investigate the threats that humans pose to the sustainability of the earth and the role that science education can play within South African schools to reduce this threat and contribute towards sustainable living.

1.3 The statement of the problem

From the previous section it is evident that the following problems exist:

- The extent to which science education can incorporate and enhance environmental education within the senior phase of the GET band.
- The extent to which science education provides an enabling environment that prepares learners for meeting the challenges of sustainable living.
- The extent to which science education develops learners' knowledge, skills, attitudes and values that facilitate the development of a competent and insightful populace, which is able to successfully engage the challenges of sustainable environmental management and lifestyle choices.

1.4 Statements of the related sub-problems

This study will, therefore

- (a) investigate whether science educators are appropriately trained to deliver environmental education.
- (b) investigate the effectiveness of support structures assisting science educators in the implementation of environmental education.

1.5 Hypotheses

The following hypotheses can be stated for this study

- a) Science education enhances environmental awareness and environmental literacy.
- b) Science education allows learners to reflect on their cultural induction and to develop critical capacities with regard to their environment.
- c) Scientific knowledge and skills are necessary for maintaining and ensuring a sustainable environment.

1.6 Summary of chapter

In order to investigate the problems which were highlighted and to test the hypotheses, research was conducted with science educators within the City of Durban Education District. The findings of the research resulted in certain generalisations and conclusions having been made, in respect of the relationship between science education and environmental education. It also facilitated recommendations for enhancing the relationship between science education and environmental education.

CHAPTER TWO

CLARIFICATION OF CONCEPTS

2.1 Introduction

This chapter serves to clarify certain concepts that are used throughout this research. The concepts 'environment' and 'environmental education' are explained. Definitions of the concept 'environmental education' are examined and the emergence and development of environmental education in South Africa is discussed. The multi-dimensional nature of environmental education is explained and a cursory look at the relationship between environmental education and science education is discussed.

2.2 The concept 'environment'

There are various definitions of the concept 'environment' (Disinger 1983). The definition that individuals subscribe to is largely based on the perspectives that these individuals share. Educators, for example, may regard the environment as being associated with the school and its community, members of the public may associate environmental issues with litter, whilst the media continue to focus on wildlife and conservation. Industrialists, for example, may disregard the socio-economic dimensions of their activities and think only of a television programme on wildlife as being environmental. While each perspective on the environment is partly valid and useful, it represents only a microcosm of the concept 'environment'. This serves to highlight the fragmentary nature and our diverse understanding of the concept 'environment' and simultaneously illustrates that the concept 'environment' is a socially constructed one, to which we attribute diverse meanings based on our own vantage points (Department of Education 2001b:5-7).

The environment is, therefore, not something that we all see and experience in the same way. Through language, experiences, exposure and interaction with other people and societies, our individual understanding of the concept environment takes shape. While these views may be diverse, they are not static and are open to change due to our ability to critically reflect on and to act when confronted with risks and environmental issues. Over time this has resulted in a broadening of our understanding of the concept 'environment.' From initially having been limited to nature and the bio-physical elements of our surroundings, it has grown to embrace the economic, social and political dimensions as well (O'Donoghue 2001:5; Rhodes University

According to the Environmental Education Policy Initiative (1995:2), the concept 'environment' not only refers to nature or nature conservation. It also includes the natural resources that society is dependent upon and the economic and social decisions that have a direct impact on the environment and the quality of people's lives. Thus, the environment is as much a matter of economic policy and social processes as it is a matter of natural systems and resources. This can be illustrated in the following way:

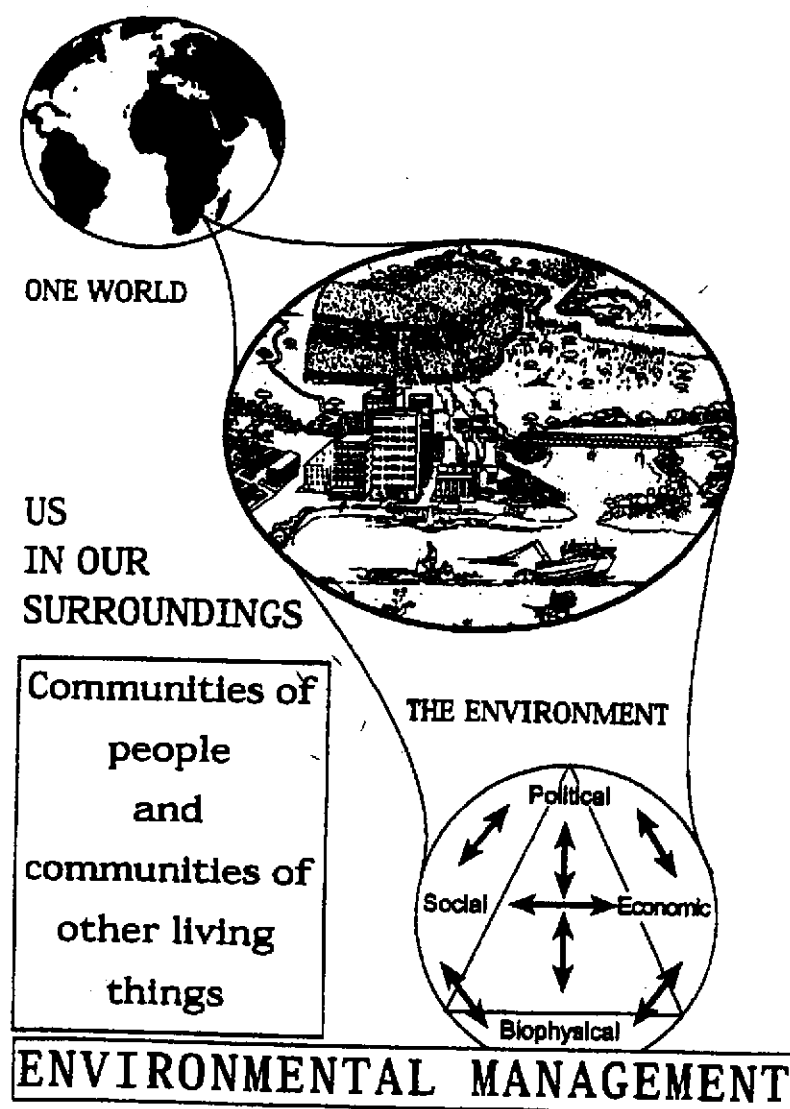


Figure 1- The environment (O'Donoghue 2001 4)

2.3 The concept 'Environmental Education' (EE)

As there are various definitions of the concept 'environment' (Department of Education 2001b:5-7), there are also various definitions of the concept 'environmental education.' The different definitions of environmental education reflect the different orientations towards environmental education, the periods of time during which they were developed and their institutional locations (Rhodes University Certificate/Gold Fields Preparatory Course In EE. Core Text Theme 2 s.a.:3).

As the environmental crisis became more evident and the sustainability of the earth was threatened by problems such as soil erosion, pollution, depletion of natural resources, overpopulation, disease, urbanisation, illiteracy, inadequate water supply and poverty (Clark 1991:3-14), international organisations attempted to take the lead in defining environmental education. Among these organisations, was the International Union for the Conservation of Natural Resources (IUCN), which in 1972 defined environmental education as-

'Environmental education is a process during which values are discovered and concepts explained in order to develop skills and attitudes pertaining to an appreciation of the relationship between man and his culture and his bio-physical environment. Environmental education also includes the practice of decision making and the formulation of a personal code of conduct on matters affecting the quality of the environment.'

Martin in Rhodes University Certificate/Gold Fields Participatory Course in EE Core Text Theme 2, considers the IUCN definition as being grounded in conservation as at the time that this definition was put forward, environmental education was predominantly concerned with bio-physical problems. Thus, Martin is of the opinion that this definition does not fully recognise the complexities of environmental education, as it does not reflect on the political, ethical and value dimensions of this area of study (Rhodes University Certificate/Gold Fields Preparatory Course In EE. Core Text Theme 2 s.a.:3-6).

Despite these criticisms of the IUCN definition, the researchers' opinion is that this definition does possess merit, as it provides a suitable point of departure from which educators can begin to approach the vast and diverse field of environmental education. As our understanding of environmental education evolved, it became necessary for educators to be cognisant of the fact that environmental education is not restricted to the bio-physical world. Rather, it permeates and must, therefore, incorporate the social, economic, political, cultural, ethical and value dimensions of our lives, thereby making environmental education a truly cross-curricular, cross-cultural and integral component of a holistic education that is necessary to initiate, guide,

moderate and temper our actions. In this way, the future survival of the earth and its kaleidoscope of life forms may be sustained for posterity.

In keeping with this evolution, in 1989 the Australian Association for Environmental Education, defined environmental education as follows:

'Environmental education is an approach to learning that is useful to individuals and groups in coming to a better understanding of the interrelationship between individuals and environments. Environmental education encourages people to develop caring and committed attitudes that will foster the desire and ability to act responsibly in their relationships with environments. Thus, environmental education is concerned with knowledge, feelings, attitudes, skills and social action' (Fien & Gough 1996:200).

From a South African perspective, the Environmental Education Policy Initiative (1995:2), views environmental education as being a field of study that seeks to develop the necessary knowledge, understanding, values, skills and commitments that allow people to become proactive in securing a healthy and properly functioning environment that is sustainable. Environmental education, therefore, facilitates the exploration of environmental issues through educational experiences and through reflection on the environment, thereby allowing learners to obtain knowledge about the environment and to develop appropriate commitments and actions for the environment (Tselane & Mosidi 1998:11).

2.4 The emergence of Environmental Education in South Africa

According to Irwin (1990:4), environmental education in its modern form emerged in South Africa in the early 1970's. Prior to this, the South African effort concentrated on outdoor education, soil erosion, and conservation education, which emphasised the wise use of natural resources and basic ecology. It did not, however, embrace the political, ethical, social and economic concerns as it presently does.

The first international conference on environmental education in South Africa took place in 1982 at the Treverton College in Mooi River, KwaZulu-Natal. This resulted in the formation of the Environmental Education Association of Southern Africa (EEASA), which has subsequently played a major role in the development and co-ordination of Environmental Education in South Africa. EEASA has played a pioneering role in convening and co-ordinating a number of workshops, seminars and conferences. It has also been involved in liaising with government departments, conservation agencies, non-government and environmental

organisations and the former liberation movements in South Africa and its neighbouring countries. By promoting the commonality that exists between people, EEASA highlighted the fact that we all share one environment and the better we share it and collectively care for it, the better the future for all of us is likely to be (Irwin 1990:5).

Organisations such as the Wilderness Leadership School, The National Environmental Awareness Council (NEAC) and the Wildlife Society of Southern Africa all played a pioneering role in the practice of Environmental Education in South Africa. In 1973, the Wildlife Society of Southern Africa launched the Umgeni Valley Project in KwaZulu Natal. This project enjoyed the support and co-operation of the Natal Education Department and the Natal Parks Board. It facilitated co-operation between organisations in both the formal and non-formal education sector and designed the first teaching materials for Environmental Education in South Africa (Loubser 1996:9).

In the former homelands of South Africa, environmental education programmes have been most successful at grassroots level, because as environments become degraded, impoverished or polluted, it is invariably the poor and the dispossessed who suffer the most. Therefore, any future enhanced quality of life for the majority of South Africans is linked to the management of our environment for the benefit of all. This has highlighted the importance of environmental education for all South Africans and has prompted several universities and colleges to offer various courses in this field of study. In 1989 a White Paper on environmental education was tabled in parliament, which unequivocally embraced the internationally accepted concept of environmental education. The liberation movements also added input about environmental issues, giving further impetus for the introduction of environmental education in SA (Irwin 1990:4–6).

In 1993 a conference was held at Dikhololo. This conference marked the beginning of the process to incorporate environmental education into the formal curriculum. This conference led to the establishment of the Environmental Education Policy Initiative (EEPI). The EEPI attempted to influence the policy and curriculum development activities around environmental education. The Environmental Education Curriculum Initiative (EECI) followed the example of the EEPI. The EECI had a great impact on the curriculum development process of Curriculum 2005 through participation in resource development and research and also attempting to strengthen curriculum development activities at colleges and universities (Sguazzin 2002:2).

According to Janse Van Rensburg (Department of Education 2001b:3), with the coming into being of a new political order in South Africa in 1994, the lobby for a formal response to the environmental concerns

became even more vociferous, demanding an expanding awareness of the relationship between environmental issues and social concerns, including development. The need for the formal introduction of environmental education became increasingly apparent in order to highlight and rectify the socially unjust conservation laws of the apartheid era. These laws protected land for the benefit of the minority, while the majority were disadvantaged in terms of access to natural resources and, therefore, were disproportionately affected by the environmental degradation. O'Donoghue (1993:29) alluded to the unique and complex environmental and educational problems that South Africa faced as a result of apartheid.

Schreuder & le Grange (2000:2), believe that most of the environmental problems in South Africa are inextricably linked to the educational crisis caused by the apartheid policies of the former government of South Africa. These policies resulted in poor education and misinformation. Poor education resulted in educational resources being inequitably distributed and benefitting only a minority sector of the population, while the majority had been left with little or no access to quality education. Mis-education characterises education of the privileged minority of the South African population and results in environmental illiteracy, overt consumerism, a lack of environmental sensitivity and the over-exploitation of natural resources. The coming into being of a new political dispensation in South Africa in 1994 necessitated the need for change and redress in South African society. When the final constitution of SA eventually had been adopted, it linked environmental issues to human rights and social responsibilities. This demonstrated the political willingness of the government to embrace environmental education for all its citizens. This is further illustrated by the fact that the 1995 White Paper on Education and Training articulated the need for environmental education processes that involve an interdisciplinary, integrated and active approach to learning (Department of Education 2001b:3-7).

2.5 The National Environmental Education Project (NEEP)

In South Africa, the most recent development in the field of environmental education is the establishment of the NEEP by the National Department of Education. The NEEP focuses on the General Education and Training (GET) band. The NEEP-GET is a response to - and offers support for - new educational policies within the context of South African environmental policies. The NEEP-GET aims to support the government of South Africa in the promotion of sustainable living through the implementation of environmental education into the GET band. The project, therefore, seeks to ensure that environmental education is integrated throughout the GET band and in all nine provinces of South Africa, in order to establish the implementation of environmental education in schools right across South Africa (Department of Education 2001a:5; Sguazzin 2001).

The project's strategy for achieving environmental learning revolves around curriculum design and revision, resource-based learning, the professional development of provincial and district staff and educators, as well as the improvement of environmental learning in schools. With regard to curriculum design and revision, the project aims at contributing to and actually shaping a national curriculum and implementation policy to ensure full-scale implementation of environmental education in South Africa. The project strives towards stimulating teaching and training institutions to engage in curriculum discussions around the incorporation of environmental education into teacher education curricular.

With respect to resource-based learning, the project emphasises the importance of resources in learning. It aims to expose educators and learners to support materials which facilitate and enhance environmental learning in schools. Selection and adaptation of learner support materials to suit the particular contexts in which educators work, would be highlighted.

The project strives towards the professional development of staff and educators, in order to positively influence environmental teaching and learning in schools within the context of curriculum 2005. This could be achieved through reflecting and developing a sophisticated understanding of the environment. In this way, the project could enhance environmental learning in schools and actually incorporate school-based environmental activities into the curriculum (Department of Education 2001a:5-10; Sguazzin 2002:6-7).

The NEEP-GET considers the major aim of environmental learning to be the development of an ability to identify, analyse and respond to environmental issues in context. Aspects of this aim and the skills and competencies that contribute to achieving it, as stated in Sguazzin (2002:21), include the ability to:

- Identify and solve environmental problems
- Understand the interconnection between systems (political, economic, ecological, cultural, social and ethical)
- Develop a historical perspective on environmental issues
- Use science and technology appropriately without detriment to life sustaining systems
- Develop action competencies to address environmental concerns
- Develop environmental literacy
- Understand the contextual and constructed nature of the environment and environmental issues
- Develop an understanding of how people perceive the environment and the consequences thereof
- Clarify personal values and perceptions related to the environment
- Access, evaluate and use environmental information

2.6 Environmental education in relation to science education

Brown, in his address to the NARST conference, described environmental education as an interdisciplinary field dominated by concepts found in the disciplines of science. Thus, he points out that the incorporation of environmental education into the teaching of science provides an ideal opportunity for promoting environmentally responsible behaviour. This is attainable, as the incorporation of environmental education into science education provides learners with learning experiences that allow them to develop ecological foundations, conceptual awareness in relation to issues and values, investigative, evaluation and environmental action skills which all facilitate the translation of learning into action. Brown emphasises that the learning of science-based environmental concepts in isolation does not constitute environmental education, but rather constitutes the study of ecology. Through the addition of an analysis of the human impact on the environment, these learning experiences fall into the domain of environmental science. However, it is only when learners are able to combine these environmental science experiences with investigative experiences and community action skills, that environmental education in its true sense occurs (Brown 2001:1-8).

Science education facilitates the study of the life-sustaining processes and systems of the bio-physical world. To understand environmental issues, we need to understand ecological systems and the physical and chemical processes which sustain them. Science education provides a solid basis for this. Understanding eco-systems is vital to understanding the impact that economic, political, social, ethical and other human activities have on the life support systems of the earth. Science education, therefore, is an integral component in developing knowledge and concepts. It provides the intellectual tools for establishing environmental risks and for conserving, developing, managing and utilising natural resources responsibly. Science education contributes to the learners' appreciation of the diversity and beauty of life. It fosters a commitment on the part of the learners to apply scientific tools for the protection and wise use of our limited natural resources, thereby contributing towards a sustainable world and enhancing the environmental experiences of learners (Department of Education 2001b:15).

2.7 The multi-dimensional nature of environmental education

In South Africa, environmental education initially had its roots in nature conservation. It has, however, since grown into a socio-ecological movement embracing many dimensions of society such as politics, ethics, sociology, culture, economics, ecological knowledge and understanding, conservation, complete

people/environment relationships and public participation in decision making. Environmental education, therefore, is all encompassing (Irwin 1990:3-4).

This is necessary as it allows us to deal both holistically and effectively with environmental challenges that have grown from mere local pollution to that of global threats and choices which have an impact on the sustainability of the world order as we perceive it. Environmental education, therefore, expresses concern about the complete environment and it has the potential to generate and sustain the knowledge, skills, attitudes and values necessary for our future survival (Fien 1993:7; Irwin 1990:3-4).

The multi-dimensional nature of environmental issues affects the bio-physical world, as well as the social systems that depend on it. People's lives are affected by environmental issues in both direct and indirect ways as a result of the interaction between these different dimensions (Department of Education 2001b:6). In this regard, O'Riordan (Irwin 1990:3), points out that environmental education encompasses what he calls the 'real conserve'. This refers to the idea that environmental education includes the real issues which cause the day-to-day hardships and deaths of people all over the world. Environmental education, therefore, seeks to establish a new environmental ethic based on the recognition of all people as being integral to nature. This highlights the need for people to work collectively towards living harmoniously, within the constraints imposed by the environment, while simultaneously utilising those opportunities which exist within the environment, effectively to ensure sustainable living.

2.8 Summary of chapter

Environmental education goes beyond the usual limits of conventional school subjects in the sense that it involves more than the development of the learner's knowledge and understanding of facts and concepts. Environmental education is geared more towards developing a framework of attitudes and values within which learners cultivate their knowledge and understanding that informs and guides their subsequent actions. The multi-dimensional nature of environmental education, therefore, ensures the development of citizens who are informed, aware, active and capable of contributing towards sustainable living (Oulton & Scott 1993:1).

Although environmental education started relatively late in South Africa, the solid foundations and practices developed over the years have entrenched it as a concept and an approach that is poised to play a meaningful role in any future attempt by society to deal with environmental crises. Environmental education, therefore, is necessary for ensuring our future sustainability.

CHAPTER THREE

SCIENCE EDUCATION AND ENVIRONMENTAL EDUCATION

3.1 Introduction

This chapter serves to highlight the symbiotic relationship which exists between science education and environmental education. The potential that science education holds for the incorporation and enhancement of environmental education through the use of science process skills and appropriate science teaching strategies, are examined and explained and the need to train science educators to facilitate the entwining of science education and environmental education, is discussed.

3.2 Achieving Environmental education through the teaching of science

Environmental education should be regarded more as an approach to teaching, rather than a body of factual content (Fien & Gough 1996:209). According to O'Donoghue *in* (Schulze 1998:96), it is, therefore, necessary for environmental education to be viewed as a sensitising focus within social processes, which inform and transform society, rather than an intervention strategy that needs to be implemented and evaluated. In this regard, science education provides an ideal launching pad for the perpetuation of environmental education. It facilitates an active and critical approach towards teaching and learning, which encourages learners to engage in concepts such as interdependence, resource management, value and lifestyle choices, social actions, risk evaluation and the seeking of alternative solutions, thereby allowing learners to make the transition to a sustainable world (Fien & Gough 1996:209).

Given the nature of most environmental issues and problems, it is internationally accepted that science education and science educators have a particularly vital role to play in enhancing and entrenching environmental education (Oulton & Scott 1993:1). According to Zint (2001:2), science education means that environmental education has traditionally been integrated into the school curriculum. However, it is now necessary for scientific knowledge and understanding to be presented in terms of social, political, economic and environmental contexts in order to remain fundamental to the resolution of various environmental issues and problems (Oulton & Scott 1993:1-2). Science education should, therefore, provide an enabling

environment within which environmental education can flourish and, thereby, continue to act as a catalyst promoting sustainable living.

Humans use and manipulate the earth's life supporting systems to live and make life comfortable for themselves. They change and adapt the environment to ensure their own survival. In the process, humans destroy/damage/deplete the earth's life supporting systems and thereby threaten its future sustainability. This is due to ignorance of the negative impact that their actions have on the environment (Tema 1999:221-222). An example of this is the willful destruction of natural vegetation and deforestation in order to accommodate the increasing number of human beings.

Scientific knowledge and science education provide a means of addressing this slide into environmental degradation. It provides an avenue for humans to reconcile tension between economic development and environmental conservation. It facilitates an understanding of environmental concerns within a socio-economic and political context and combines environmental and developmental concerns. It, therefore, helps to strengthen human capacities by fostering a respect for freedom, peace and the diversity of life. It encourages community participation based on equality and a solidarity world -view towards the environmental and developmental problems which human beings face. By understanding these problems and seeking solutions to them, humans come to realise that these environmental problems are not only the result of physical and biological factors. An understanding of the roles played by the aesthetic, social, economic, political, historical and cultural elements is necessary for a broader understanding and possible solving of problems. Such problems include the depletion of natural resources, climatic change, land use management, deforestation, desertification, waste disposal, pollution, mass extinction of species, exponential population growth, poverty and famine (Tema 1999:222 –226).

Dr BSNgubane, the South African Minister of Arts, Science and Technology, alluded to the pivotal role which science and technology play in ensuring sustainable development and sustainable living. As human sustainability is largely dependent on their use of and care of the environment, the role that science education plays in ensuring sustainability becomes more prominent. He referred to science as an instrument that has a defined purpose, making it the handmaiden of more advanced goals, through developing learners into problem solvers, innovators, entrepreneurs and community leaders. It, therefore, facilitates the development of a scientifically literate community and these communities have historically demonstrated the highest rate

of economic development, the highest commitment to democratic values and have created an enduring and sustainable quality of life (Ngubane 2001).

The value of science education through environmental education lies in the emphasis that science education places on critical thinking about environmental issues and risks that may have an impact on our future sustainability. Through the use of science process skills, learners are effectively prepared to think critically and to act as agents of change and environmental protection.

They acquire the ability to identify environmental issues and risks and also to investigate these with a view towards seeking possible solutions to them. Learners engage in action and by evaluating the environmental impact and effectiveness of their actions, they develop into active participants who are able to think and act in a critical and rational manner, as opposed to being reduced to mere recipients of decisions.

3.3 The science process skills

3.3.1 What are science process skills?

Science process skills, as defined by Screen in (Arena 1996:34), are the sequence of events that are engaged by researchers while participating in a scientific investigation. Goh, Toh and Chia in Arena (1996:34), regard science process skills as being associated with the cognitive skills which accompany scientific investigations. It is apparent from these definitions that science process skills are educationally important and an essential characteristic of science education, as it encourages learners to think and work scientifically within an investigative framework, thereby enhancing learners' reasoning abilities and promoting scientific and technological literacy.

Generally, it is agreed that a hierarchy of science process skills exists. The more complex skills are referred to as the 'higher order' or 'integrated skills,' while the less complex or lower order skills are referred to as 'basic skills.' The integrated process skills rely upon more sophisticated, cognitive abilities and include skills such as hypothesising, identifying and controlling variables, defining operationally, interpreting data, graphics and experimenting. The basic skills encompass skills such as predicting, observing, measuring, inferring, classifying using number/space/time relations and recording and displaying data. According to Gagne in Preece & Brotherton (1995:5), the basic skills are the foundation of the scientific method. These

ought to be mastered first, thereby facilitating the effective use of the integrated skills. The nature of science process skills require that they need to be overtly taught and reinforced in science education. Science educators, therefore, need to actively incorporate these skills into their teaching of science.

3.3.2 The role of the science process skill

An essential characteristic of science education is that it introduces learners to scientific methods through the teaching of the science process skills. These science process skills promote scientific literacy amongst learners and developing their scientific competencies by providing them with opportunities for decision making and selecting observations which are relevant to their investigations. It facilitates the search for and actual identification of patterns and allows for these patterns to be related to formerly perceived patterns.

It also plays a significant role in suggesting explanations for and evaluating explanations of these patterns. It facilitates the design of experiments and the conduction of experiments. It allows for appropriate forms of measurement to test and verify suggested explanations for the patterns of observations. It facilitates communication, which could be either verbal, mathematical or graphical and the interpretation of written, verbal and other communiqué. It allows for the safe and effective use of equipment and provides knowledge in an attempt to solve technical and logistical problems (Millar & Driver 1987:34).

In addition to these functions, Lee (1993) has identified several other functions that the science process skills satisfy. These include providing educators with a proper understanding of scientific methods so that they can instill these skills effectively in their learners, thereby enhancing their own teaching and actually encouraging learners to work in a collaborative environment. Sherwood and Gabel *in* (Lee 1993:627), have found that the science process skills improve learners' attitudes towards science. Learners view science as being relevant in their everyday lives and necessary for enhancing their quality of life. Baird and Borich *in* (Lee 1993:627) have found that the science process skills enhance the cognitive development of learners. Gagne *in* Millar & Driver (1987:35), is of the opinion that the acquisition of scientific concepts and principals can only be achieved through the operation of the science process skills. These scientific concepts and principals are fundamental to scientific reasoning in response to problem solving environments. This view is supported by Lawson and Norman *in* Lee (1993:627), who found that there is a correlation between the use of the science process skills, the scientific knowledge of learners and the cognitive development of the learners.

Science education involves the acquisition of a range of process skills that may be used in everyday life, in the community and in the workplace. These skills must be acquired in an environment which supports creativity, responsibility and increased confidence. The use of science process skills develop attitudes of objectivity, as well as reason and encourages learners to engage in investigations, to reflect upon and analyse situations and to be able to communicate about these situations, thereby preparing learners for economic activity and self-expression. Learners are provided with a base for further study in science and are prepared for active participation in a democratic society which values human rights and promotes environmental sustainability (National Curriculum Statement 2001:3).

3.4 Science teaching strategies

3.4.1 Factors that influence the teaching strategies used

The range of backgrounds and differences in the experiences of both educators and learners, calls for an imaginative range of teaching strategies to facilitate the teaching and learning of science, with a view towards supporting and implementing environmental education. The strategy that an educator would adopt is influenced by various factors. These include the educator's past experiences, his/her abilities, the availability of resources, the aims, objectives and outcomes of the course, the duration of the lesson and the number of learners in the class (Arce 1994:146; Palmer 1997:79).

When adopting a strategy, it is necessary for educators to be cognisant of the fact that learners bring their own understanding of the world into the classroom. These understandings are widespread across age, gender and communities and highly durable. Whatever strategies are employed, the existence of such understandings and the need to work with them must be recognised, so as to modify and /or rectify them, thereby removing any misunderstanding and/or misconceptions. In this way, learners' understanding is enhanced (National Curriculum Statement 2001:3). Science education provides learners with opportunities to encounter experiences which facilitate a critical reflection on their cultural induction. Learners become active participants in the learning process. They seek information and take action relating to environmental issues and risks, thereby contributing towards a sustainable environment and sustainable living (O' Donoghue 2001:5).

In this research, science teaching strategies which are demonstratively the most appropriate in promoting environmental education and thus promoting sustainable living, are highlighted.

3.4.2 Science teaching strategies promoting environmental education

3.4.2.1 The constructivist approach

This is an approach that views learners as being active participants in the learning process. The learners assume responsibility for their own learning through the active construction of meaning. In so doing, learners utilise their existing ideas, beliefs and conceptual schemes and interpret any new information in the light of thereof. This may result in their original ideas being modified or revised in order to accommodate the new information received.

For this strategy to be successful, educators should see their role function as being a facilitator of knowledge construction, as opposed to being a transmitter of knowledge. Educators, therefore, need to create a supportive and conducive environment within which learners are motivated to explore new ideas and seek solutions for themselves through the manipulation of objects and materials in their environments. Learners must be encouraged to propose, design and carry out investigations and to reflect on what had been done. Shymansky, Hedges and Woodworth *in* Palmer (1997:74), point out that such a hands-on, inquiring type of approach to the teaching of science results in higher achievement, improved skills and a more positive attitude on the part of the learners (Hand & Vance 1995:37-38; Palmer 1997:73-74).

Palmer (1997:76-79), proposes a strategy to implement the constructivist approach in the teaching of science. His strategy is a two step process. The first step is called 'interactive demonstration' and involves the utilisation of the basic process skills such as observing, predicting, measuring, inferring and recording data with a view towards explaining observations in their environment. The second step is called 'investigation of context' and involves expanding the learners' understanding of phenomena observed in a range of different contexts in their environment. Learners are encouraged to carry out further investigations and thereby utilising the higher process skills. This strategy allows learners an opportunity to express their own views and to consider the views of others. It, therefore, facilitates collaboration by linking new experiences with previous experiences in the environment. It allows learners opportunities to make predictions and observations in order to propose further investigation and to devise ways of carrying out these investigations.

Learners are encouraged to reason about the world and to relate their learning to other experiences in their environment.

3.4.2.2 Group work

Group work is increasingly being seen as a suitable strategy for implementing environmental education. It facilitates problem solving, discussions, seminars, debates and dialogue amongst peers (Oulton & Scott 1993:6). Within small working groups, ideas can be introduced, discussed, explained and critically evaluated. It provides an ideal forum for learners to explore their knowledge and to develop and enhance their understanding of phenomena in their environment. Learners are provided with opportunities to share ideas, beliefs and findings in a non-threatening and non-judgemental environment. Learning becomes an exciting cultural product within which reasoning and constructive criticisms are encouraged (Osborne 1997:62-63).

The value of group work lies in the fact that different individuals bring different experiences and points of view to the group (Osborne 1997:61-62). In attempting to resolve a particular issue in relation to the environment, these differences stimulate healthy debate and facilitate a consideration of social, political, economic, cultural and ethical concerns. Learners come to the realisation that they are able to take action to reverse the destructive influences that human actions have on the environment. They, therefore, have the capacity to change their environment and enhance their quality of life.

3.4.2.3 The colloquial approach

This is an example of an active learning approach that has been proposed by Arce (1994). This is a learner-centred approach, as the learner is the main driving force in the learning process. The educator's role is to provide guidance, co-ordinate and stimulate discussion in order for learners to acquire new concepts and solutions to problems. This can be achieved by posing questions to learners and/or by presenting different scenarios, or alternate points of view, which may be either correct or incorrect, thereby promoting discussion and provoking the learners' intellect. The learning environment becomes a dynamic one in which the learner's fear of being wrong is eliminated, as emphasis is placed on the free interchange of ideas. The active participation of learners is central to the resolution of environmental concerns. Through their active involvement, learners assume responsibility for the state of the environment and are able to engage in activities that contribute towards an enhanced environment within which our future sustainability is ensured.

3.4.2.4 Interactive learning

De Beer (1995:22-24) supports the view that in order for effective learning to occur, learners must become active participants in the learning process. This facilitates learners making the transition from being passive listeners to becoming active and energetic participants who develop the confidence and skills necessary to effectively apply their scientific knowledge to environmental concerns. Group work, question and answer methods and role-playing are some of the interactive strategies that could be utilised.

Cherif and Somervill (1995:28) have found that role-playing, by drawing on the learners' past experiences, generate enthusiasm and encourage their active involvement in the learning process. This strategy provides learners with opportunities for acting out conflict, collecting information about social issues and taking on the roles of others. Thus, learners are provided with unique opportunities for resolving interpersonal and social dilemmas and it facilitates co-operation in a multicultural environment.

Interactive learning, therefore, contributes towards creating awareness and sensitising learners to the environmental concerns. Through acting out and discussing their concerns, learners are encouraged to collaborate with one another and other role players in society. It facilitates a corporate responsibility for the state of the environment and its future sustainability.

3.4.2.5 Supported self-study

With this strategy, learners are required to become active participants in the learning process. They are required to search for information themselves. The responsibility for learning lies with the learners and is dependent on their level of motivation. Learners set targets for themselves and organise their activities, in order to effectively use their time to achieve their targets. The educator serves to guide learners through these processes and to direct them to suitable resources and goals, depending on their abilities and aptitude. There is a distinct shift in focus from the educator to the learner. This method of teaching science has several benefits. It helps learners to work faster and focus the majority of their time on the tasks at hand. Learners are given greater responsibility for their learning and this encourages independent learning. Group work techniques and teacher learner rapport is improved. Learners are better motivated and the learning environment is less intimidating. Equipment can be more effectively managed and practical work can be

spread out over several lessons, thereby maximising opportunities for the development and acquisition of the science process skills (Calder & Parkinson 1994:112-114).

Supported self-study, therefore, makes an important contribution towards the learning of science and the establishment of an environmental ethic. Learners are given the opportunity to investigate those environmental concerns which are of interest to them and have relevance to their local communities. In seeking solutions to local issues, learners make comparisons to other communities and learn of new and novel ways to solve their local problems. It is possible that these solutions could be extrapolated to a national and international arena.

3.5 The need to train science educators for the teaching of environmental education

If the potential of science education for enhancing the delivery of environmental education is to be realised, science educators must be appropriately trained and educated in the various methods that contribute towards harnessing the potential of science education for incorporating and enhancing environmental education. If science educators are to be successful in establishing a culture of environmental learning, they themselves need to be adequately prepared for meeting the challenge. According to Schreuder and le Grange (2001:3), the failure to adequately prepare educators through providing them with the appropriate training, results in under-qualified and unmotivated educators who become suspicious of initiatives that they do not regard as being transparent and participative.

The training of educators is of paramount importance, as it builds capacity amongst educators, thereby enabling them to embrace change and to bring about change in their classrooms. Oulton and Scott (1993:3-6), have found that not all science educators possess the necessary knowledge, skills, abilities or inclination to deliver environmental education in its true sense. In relation to the South African context, these findings are supported by the findings of the Department of Education (2001b:21). In a pilot project undertaken by the department of education, called 'Learning for Sustainability', it was established that many educators showed only a superficial understanding of environmental issues. These educators possessed a limited capacity to identify environmental issues which are relevant to the achievement of curriculum outcomes and experienced difficulty in utilising the available resources to explore such issues. As a result of these shortcomings, these educators were limited to developing and implementing superficial curriculum activities that failed to achieve environmental learning with the appropriate scope and depth. These limitations are a legacy of the teacher

training programmes which did not emphasise environmental education. Williams *in* Oulton and Scott (1993:4), identified a number of factors that militate against the effective incorporation of environmental education into teacher training courses. These include time constraints, staff and resource shortages, a lack of experience and expertise amongst staff in respect to environmental education, competing areas of study within teacher training courses and the interest and priorities of the students themselves. These shortcomings should immediately be addressed by developing appropriate in-service support programmes and conducting workshops and seminars that focus on environmental education. In-service educators have to receive guidance for achieving environmental learning.

These shortcomings must be prevented in future through meaningfully redesigned pre-service programs. These programmes must prepare educators to mediate learning in order to achieve environmental learning outcomes. These should assist educators in designing and adopting learning programmes and identifying and utilising local issues as a basis for developing such learning programmes.

In this regard Carlsen (2001:2-4) believes that science educators must be trained and encouraged to utilise the environment as a resource in their teaching of science, as the environment provides a rich terrain for educators to engage their learners in scientific inquiry. Learners are familiar with their local environments and investigations conducted within these environments help to bridge the gap between the familiar and the novel. By utilising the local environment, educators and learners become environmentally sensitive and are able to engage in activities in the environment, about the environment and for the environment. In this way, science educators transcend their traditional rigidness of limiting science learning to the laboratory and are able to incorporate social concerns into their teaching and learning of science, thereby increasing the appeal of science to a wider range of learners by making science culturally and socially relevant.

According to Meichtry (2001:50), the extent to which the synergy between science education and environmental education can be realised, is largely dependent on the degree of educational training that the educator has received with regard to integrating science education and environmental education. This idea is further supported by Smith and Williams *in* Zandvliet (2001:40), who point out that teacher training must encourage educators to develop a personal affinity for the environment and to ground learning in a sense of place through utilising the environment as a resource. Educators must, therefore, be trained to engage learners in group work activities and to help learners acquire the science process skills through active involvement with the environment. In this way, learners are prepared for work as activists who are able to

negotiate structures/policies supporting social justice and to offer criticism on the cultural assumptions upon which modern industrial civilisations have been built. Therefore, the incorporation of environmental education into the teacher training courses for science educators, is central to the success of the symbiotic relationship between science education and environmental education.

3.6 Summary of chapter

The science process skills are central to the teaching of science. Through the acquisition and utilisation of the science process skills, the potential of science education for enhancing the delivery of environmental education is enhanced. Learners develop their investigative skills and learn to reflect on issues critically and from different perspectives. The teaching strategies that are employed need to reflect this approach towards education.

According to Robottom *in* (Oulton & Scott 1993:8), for science teaching strategies to promote environmental education, these need to be enquiry based, using an action research approach. These teaching strategies should promote the participation of all learners and must be practice based, in order to develop the ideas and theories of environmental practitioners. The strategies used must encourage critical reflection on the part of the learners in such a way that learners are able to consider the values and assumptions that envelop environmental education. The strategies used must be community based, as environmental issues are often unique to communities and can only be solved through the collaboration of all role players within the community. This is in keeping with the views of Rene Dubos (Arms 1994:7) who believes that local action paves the way for global thinking and global sustainability.

CHAPTER FOUR

DESIGN OF THE RESEARCH OF THIS STUDY

4.1 Introduction

This chapter serves to place the research methodology in context. According to Tuckman (1994:4), research is a systematic attempt to provide answers to questions. In attempting to answer questions, research becomes both a creative and intellectual activity. It is, therefore, defined as 'the systematic and objective analysis and recording of controlled observations that may lead to the development of generalisations, principles, or theories, resulting in prediction and possibly ultimate control of events' (Best & Kahn 1993:27-28). The question being asked in this research is:

What is the relationship between science education and environmental education?

In attempting to answer this question, the research approach which was followed, was a qualitative descriptive approach. This approach uses systematic procedures to discover nonquantifiable relationships between existing variables (Best & Kahn 1993:26-27). This entailed the researcher conducting interviews with school based educators who are responsible for the teaching of natural science at schools within the city of Durban, in order to ascertain the relationship between science education and environmental education.

The research was accordingly designed to achieve the following objectives:

- to determine educators' understanding of the concept 'environmental education'
- to determine the extent to which educators are able to use science education, as a conduit for delivering environmental education
- to determine those factors (if any do exist) which militate against the delivery of environmental education

4.2 Delimitations in respect of this research

4.2.1 Geographical delimitations

The geographic delimitations of this research were determined by factors such as proximity of the areas to the researcher, affordability of this research and accessibility of the areas to the researcher.

- South Africa consists of nine provinces (see figure 2).

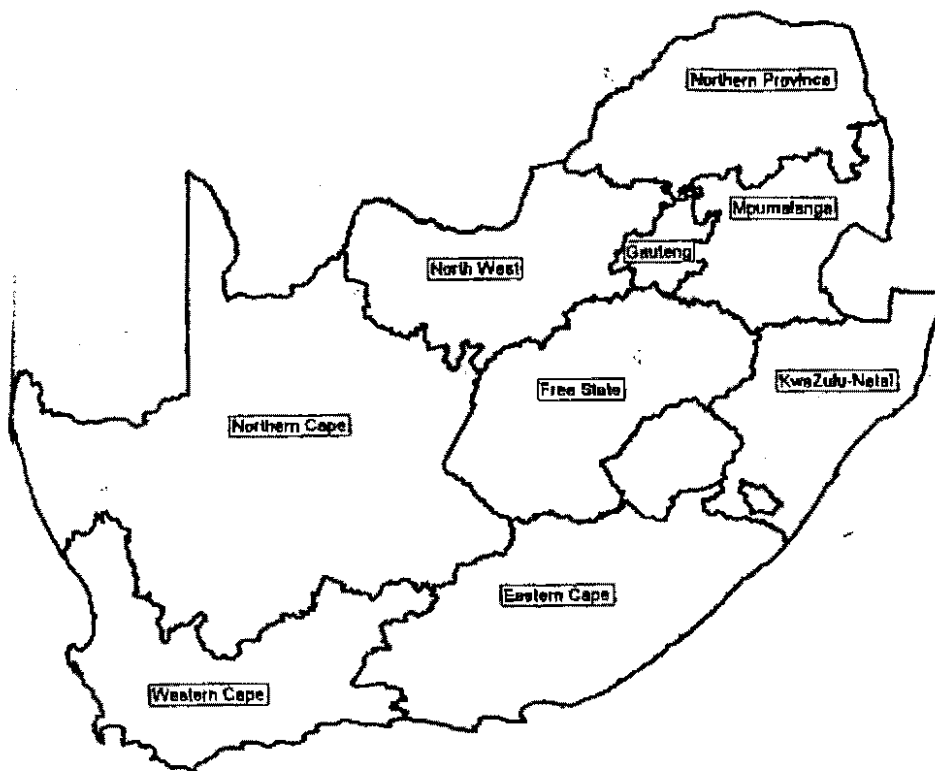


Figure 2: The nine provinces in South Africa

This research was limited to the province of KwaZulu-Natal. The KwaZulu-Natal Department of Education and Culture (KZNDEC) comprises eight regions (Figure 3), namely:

- Durban North
- Durban South
- Port Shepstone
- Pietermaritzburg
- Ladysmith
- Vryheid
- Ulundi
- Empangeni

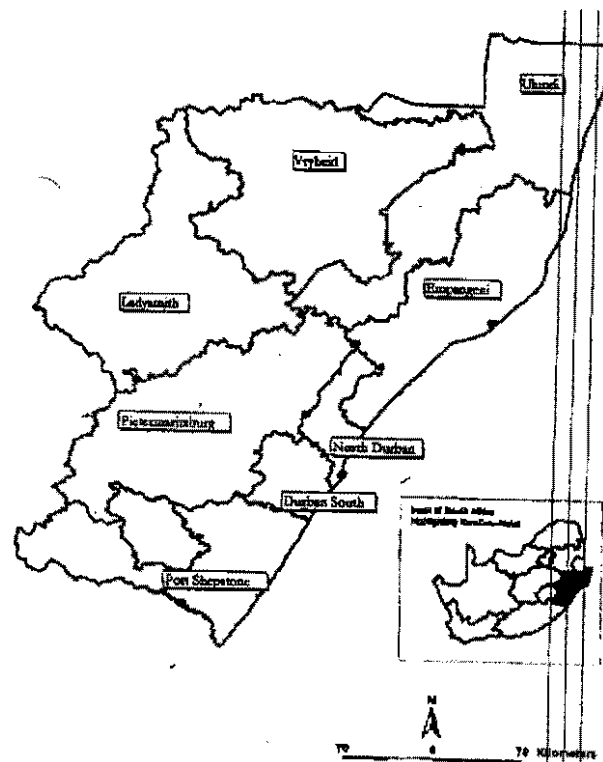


Figure 3: The eight regions in Kwazulu-Natal

This research was limited to the North Durban Region.

The North Durban Region comprises six districts, namely:

- The City of Durban
- Inanda
- Kwamashu
- Maphumulu
- Ndwedwe
- Phoenix

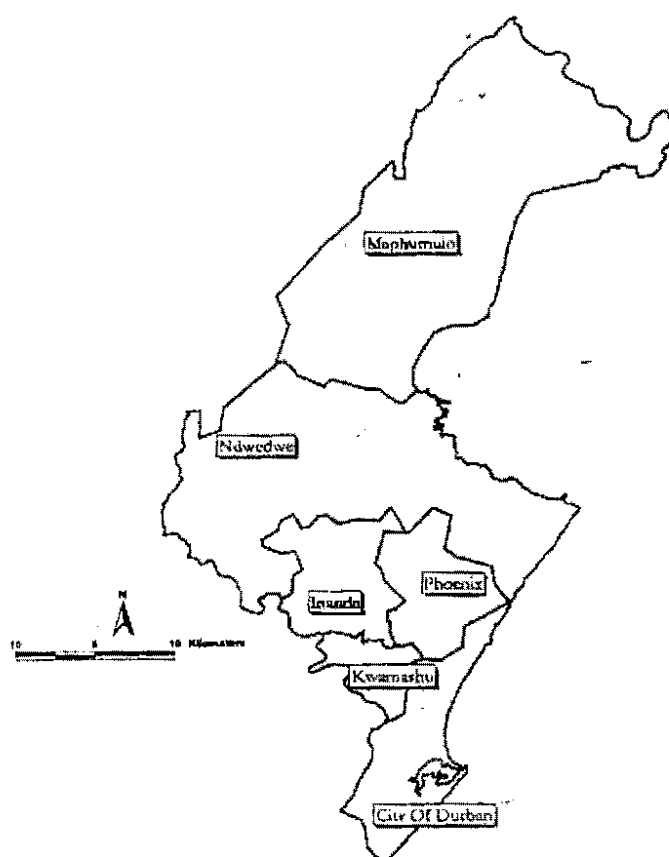


Figure 4: The six districts of the City of Durban

This research was limited to the City of Durban (see figure 4).

- The City Of Durban comprises five circuits, namely:
- Durban Central
- Merewent
- Port Natal
- Umgeni North
- Umgeni South

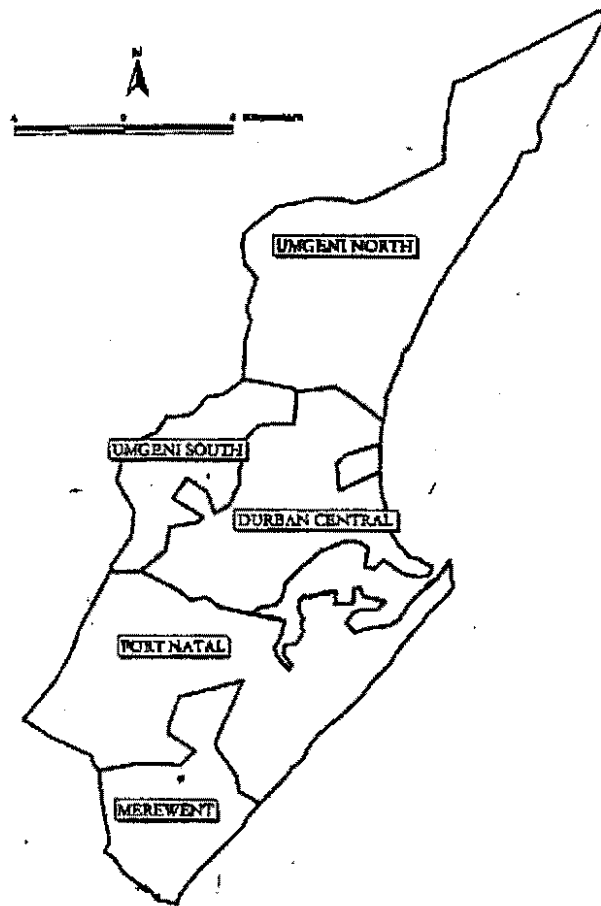


Figure 5: The five circuits in the City of Durban

This research took place across all five circuits in the City Of Durban (see figure 5).

4.2.2 Learning area delimitations

This research attempts to examine the extent to which science education can incorporate and enhance teaching and learning about the environment, in the environment and for the environment. In this research, science education was limited to the learning area of natural science. With the advent of outcomes based education (OBE) in South Africa, natural science has become a compulsory learning area for all learners in grades 7, 8 and 9 of the senior phase in the General Education and Training Band (GET).

The natural science learning area encompasses aspects of the traditional school subjects such as General Science, Biology, Physical Science, Chemistry and Geography. The natural science learning area is committed to broadening access to materials, resources, knowledge acquisition and the conceptual development of all learners. This learning area, therefore, strives towards redressing the imbalances that were created by the apartheid policies of the former government by contributing towards the socio-economic development of the country in order to achieve a better life for all the citizens of South Africa (Department of Education 1997:NS3).

In this research, the natural science learning area was utilised to determine the extent to which science education can incorporate and enhance the delivery of environmental education.

4.3 Schools within the City of Durban circuit

The following information presented, has been obtained from the KZNDEC, courtesy of the Educational Management Information Services (EMIS) in the Durban North Region.

The City of Durban has a total of forty-nine secondary and combined schools. All forty-nine schools offer natural science as a learning area to learners in grades 7,8 and 9, in other words in the senior phase of the GET band. The forty-nine schools are located across all five circuits of the City of Durban. Of the forty-nine schools, there are ten independent schools and thirty-nine public schools (see figure 6).

			TYPE	LEVEL	7-9	10-11	12-13		
1	DURBAN CENTRAL	DURBAN FINISHING SCHOOL	PUB	DET	SEC	133	0	189	0
2	DURBAN CENTRAL	DURBAN GIRLS COLLEGE	IND	HOA	COMB	90	62	83	47
3	DURBAN CENTRAL	DURBAN GIRLS H (Panzance Road)	PUB	HOA	SEC	282	0	260	0
4	DURBAN CENTRAL	DURBAN GIRLS S (Dartnell Cres)	PUB	HOD	SEC	240	0	231	0
5	DURBAN CENTRAL	DURBAN H (DHS)	PUB	HOA	SEC	247	0	183	0
6	DURBAN CENTRAL	GEORGE CAMPBELL TECHNICAL HIGH SCHOOL	PUB	HOA	SEC	188	0	229	0
7	DURBAN CENTRAL	GLENWOOD HIGH SCHOOL	PUB	HOA	SEC	236	0	238	0
8	DURBAN CENTRAL	HOLY FAMILY COLLEGE (Glenwood)	IND	HOA	COMB	2	27	20	12
9	DURBAN CENTRAL	INTERNATIONAL CHRISTIAN ACADEMY	IND		COMB	19	13	28	15
10	DURBAN CENTRAL	MARIS STELLA	IND	HOA	COMB	73	49	69	71
11	DURBAN CENTRAL	MAYVILLE S	PUB		SEC	187	0	247	0
12	DURBAN CENTRAL	ORIENT ISLAMIC	IND	HOD	COMB	127	74	108	71
13	DURBAN CENTRAL	RIDGE PARK COLLEGE	PUB	HOA	SEC	224	0	225	0
14	DURBAN CENTRAL	SASTRI COLLEGE	PUB	HOD	SEC	180	0	247	0
15	DURBAN CENTRAL	ST HENRY'S MARIST BROTHERS' C	IND	HOA	COMB	60	45	55	51
16	MEREWENT	CLAIRWOOD S	PUB	HOD	SEC	367	0	242	0
17	MEREWENT	FAIRVALE S	PUB	HOR	SEC	244	0	258	0
18	MEREWENT	GANGES S	PUB	HOD	SEC	233	0	219	0
19	MEREWENT	INTERFELLOWSHIP CHRISTIAN	IND	DET	COMB	123	26	108	28
20	MEREWENT	MEREBANK S	PUB	HOD	SEC	290	0	270	0
21	MEREWENT	PR PATHER S	PUB	HOD	SEC	222	0	149	0
22	MEREWENT	UMBULO S	PUB	HOR	SEC	231	0	225	0
23	MEREWENT	WENTWORTH S	PUB	HOR	SEC	288	0	250	0
24	PORT NATAL	BRETTONWOOD H	PUB	HOA	SEC	194	0	95	0
25	PORT NATAL	DURBAN ACADEMY H	PUB	HOA	SEC	162	0	153	0
26	PORT NATAL	GROSVENOR BOYS' H	PUB	HOA	SEC	108	0	134	0
27	PORT NATAL	GROSVENOR GIRLS H	PUB	HOA	SEC	188	0	188	0
28	PORT NATAL	MOWAT PARK H	PUB	HOA	SEC	175	0	166	0
29	PORT NATAL	NEW FOREST H	PUB	HOA	SEC	0	0	186	0
30	PORT NATAL	PHAMBILI H	PUB	DET	SEC	89	0	91	0
31	PORT NATAL	PORT NATAL H	PUB	HOA	COMB	121	75	103	72
32	UMGENI NORTH	AVOCA S	PUB	HOD	SEC	187	0	161	0
33	UMGENI NORTH	DANVILLE PARK GIRLS' H	PUB	HOA	SEC	163	0	175	0

Figure 6a: List of secondary and combined schools in the City of Durban

34	UMGENI NORTH	DURBAN NORTH COLLEGE	PUB	HOA	COMB	47	38	53	30
35	UMGENI NORTH	EFFINGHAM S	PUB	HOD	SEC	178	0	134	0
36	UMGENI NORTH	NORTLANDS GIRLS H	PUB	HOA	SEC	243	0	172	0
37	UMGENI NORTH	NORTHWOOD H	PUB	HOA	SEC	287	0	247	0
38	UMGENI NORTH	OUR LADY OF FATIMA CONVENT	IND	HOA	COMB	57	58	58	58
39	UMGENI NORTH	PARKHILL S	PUB	HOR	SEC	220	0	220	0
40	UMGENI NORTH	SEA COW LAKE S	PUB	HOD	SEC	199	0	188	0
41	UMGENI SOUTH	AL FALAAB COLLEGE DURBAN	IND	HOD	COMB	78	51	51	77
42	UMGENI SOUTH	BECHET S	PUB	HOR	SEC	281	0	248	0
43	UMGENI SOUTH	BONELA S	PUB	HOD	COMB	271	155	174	198
44	UMGENI SOUTH	BURNWOOD S	PUB	HOD	COMB	193	22	181	25
45	UMGENI SOUTH	CENTENARY S	PUB	HOD	SEC	225	0	223	0
46	UMGENI SOUTH	CRESCENT GIRLS H	IND		COMB	77	13	0	0
47	UMGENI SOUTH	OVERPORT S	PUB	HOD	SEC	238	0	224	0
48	UMGENI SOUTH	SPARKS ESTATE S	PUB	HOR	SEC	184	0	228	0
49	UMGENI SOUTH	WIGGINS S	PUB		SEC	195	0	148	0

Figure 6b: List of secondary and combined schools in the City of Durban

Prior to 1996, the schools in this education district were administered as follows:

- Three schools within this circuit were administered by the former Department of Education and Training (DET).
- Twenty-one schools were administered by the former Natal Education Department (NED), which was a sub-division of the former House of Assembly (HOA).
- Fifteen schools were administered by the former House of Delegates (HOD).
- Six schools were administered by the former House of Representatives (HOR).
- Four schools in this circuit were built after 1996 and, therefore, were not administered by any former departments of education.

In this research, the schools were separated into public (39) and independent (10) schools. The numbers of schools per circuit are as follows:

- Durban Central - 9 public schools and 6 independent schools
- Merewent - 7 public schools and 1 independent school
- Port Natal - 8 public schools and no independent schools
- Umgeni North - 8 public schools and 1 independent school
- Umgeni South - 7 public schools and 2 independent schools

4.4 Selecting the sample

The results of any research are largely dependent on the quality of the sample and on how representative the sample is (Leedy 1993:198). Sampling involves selecting a portion of the population that has been identified for observation and analysis (Best & Kahn 1993:13). This selected portion of the population is called the 'sample.' The researcher studies/observes the sample and generalises the findings of the research to the entire population (Ary et al 1990:169). Sampling, therefore, enables the researcher to study a portion of the population as opposed to studying the entire population and also to make valid inferences or generalisations which are applicable to the entire population (Best & Kahn 1993:13).

In order to make the sample as representative as possible, the researcher adopted the use of probability sampling. Ary et al (1990:171-172) defines probability sampling as the kind of sampling in which 'every

element in the population has a non-zero chance of being selected.' The selection of the sample should, therefore, take place by chance and this is achieved through the process of randomisation. Randomisation facilitates the selection of a sample which is representative of the population about which the researcher wishes to generalise (Best & Kahn 1993:14).

The researcher stipulated that at least twenty percent (20%), rounded off to the nearest whole figure of both public and independent schools, be represented in a randomly selected sample. In selecting the sample for public schools, it was stipulated that schools from each of the five circuits within the City of Durban should be represented in the sample. These stipulations resulted in the subdivision of the schools into smaller homogeneous groups, represented by the circuits, thereby facilitating a more accurate representation of schools in the sample. This type of sampling is classified as a 'stratified random sample' (Ary et al 1990:173-174).

4.4.1 Selecting the sample of public schools

A twenty percent (20%) random sample of public schools was selected as follows:

- The 39 public schools were grouped into their respective circuits
- Within each circuit, the schools were named alphabetically and numbered in sequence on pieces of paper as follows:
 - Numbers 1-9 represented schools in the Durban Central Circuit
 - Numbers 10-16 represented schools in the Merewent Circuit
 - Numbers 17-24 represented schools in the Port Natal Circuit
 - Numbers 25-32 represented schools in the Umgeni North Circuit
 - Numbers 33-39 represented schools in the Umgeni South Circuit
- A 20% sample of schools for each circuit was selected afterwards

The pieces of paper numbered 1-9 were folded tightly, placed into a packet and shaken about

- A colleague was then requested to pick a 20% sample of schools (rounded off to the nearest whole

figure)

Since a 20% sample of 9 schools = 1.8 schools, 2 schools were selected for this circuit.

- The process was repeated for each of the remaining 4 circuits
- As a result of using this method, 2 schools were selected for the Durban Central Circuit, 1 school was selected for the Merewent Circuit, 2 schools were selected for the Port Natal Circuit, 2 schools were selected for the Umgeni North Circuit and 1 school was selected for the Umgeni South Circuit.
- Thus, 8 schools out of the 39 public schools (across all 5 circuits) were randomly selected to participate in this research.

4.4.2 Selecting the sample of independent schools

The selection of the sample of independent schools proved to be more challenging, as these schools were not evenly distributed across all 5 circuits. A 20% sample also required the researcher to select 2 schools out of the 10 independent schools within the City of Durban circuit. As the majority of these schools (6) are located within the Durban Central Circuit, 1 school was selected from this circuit. The other 3 circuits that included independent schools, namely Merewent (1 school), Umgeni North (1 school) and Umgeni South (2 schools), were combined to select 1 school.

The following method was used:

- a) The schools were named alphabetically and numbered sequentially on pieces of paper as follows:

Numbers 40-45 represented schools in the Durban Central Circuit.

Numbers 46-49 represented schools in the Merewent, Umgeni North and Umgeni South Circuits.

- b) The pieces of paper numbered 40-45 were folded tightly, placed in a packet and shaken about.
- c) A colleague was then asked to pick 1 school.
- d) The pieces of paper numbered 46-49 were folded tightly, placed in a packet and shaken about.

- e) A colleague was again asked to select 1 school.
- f) In this way, 2 schools out of the 10 independent schools were randomly selected to participate in this research. One independent school which was selected, was from the Durban Central Circuit and the other one was from the Umgeni South Circuit.

4.5 Preparing for the interview

For the purpose of this research, interviews were used as the dominant strategy for data collection. Careful consideration was, therefore, given to designing the questions to be asked at the interviews so that the data obtained would contribute towards enhancing the researchers' understanding of the relationship between environmental education and science education. This data would also serve as a basis for the formulation of certain conclusions and generalisations and allow the researcher to make certain recommendations towards innovative and improved methodologies which could enhance the synergy between environmental education and science education.

The questions for the interview (see appendix C) were designed to primarily illicit qualitative data from the interviewees. The questions were carefully planned beforehand and unambiguously phrased, in order to facilitate interpretation of the questions by the interviewees. The questions were also designed to fulfill the research objectives as outlined in paragraph 4.1 of this chapter.

As the researcher required qualitative responses from the interviewees, the questions were designed to be open-ended and did not stipulate predetermined responses from the interviewees. The interviewees were afforded the opportunity to interpret the questions and respond to the questions, in the context of their unique personal and institutional circumstances. Descriptive responses, as a result of these circumstances, were, therefore, encouraged.

The specific wording and sequence of the questions were determined by the researcher in advance. All the interviewees were asked the same questions in exactly the same order during their interviews. The open-ended nature of the questions encouraged descriptive responses in respect of the unique personal and institutional circumstances of the interviewees. Best and Kahn (1993:200-201) classify such an interview as a standardised open-ended interview which serves to access the different perspectives of the interviewees,

without allowing the researcher's perspectives to influence the interviewees' responses, thereby preventing biased and misleading data being presented.

The questions for the interviews were faxed to the interviewees' schools at least seven days prior to the interview being conducted. The purpose of doing this, was to allow the interviewees sufficient time to acquaint themselves with the questions and to seek clarity on any ambiguity that they may have encountered with the questions.

Prior to the actual commencement of the interview, the researcher enquired from the interviewees whether there were any questions which were unclear/ambiguous and if they required clarity on any aspect of the questions. The need for the interviewees to respond honestly, in respect of their personal and institutional circumstances, was emphasised. The researcher also provided the interviewees with the assurance that no individual educator and/or school would be singled out in the research report.

Finally, the researcher assured the interviewees that their responses would not be categorised either as correct or incorrect, but rather, that their responses would be analysed with a view towards empowering educators through enhancing their delivery of environmental education within the school situation. All interviews were conducted at the convenience of the interviewees. The researcher, therefore, met the interviewees either at their homes or schools, at the request of the interviewees.

4.6 Permission to conduct research

Permission to conduct this research was requested from the KZNDEC. In this regard, two letters were addressed to Dr D W M Edley – The Regional Co-ordinator: Research, North Durban Region (see appendix A & B). Permission was granted for the researcher to first visit the North Durban Regional Office in order to obtain statistical and structural information relating to schools within the North Durban Region and the City of Durban in particular (see appendix E). Permission was also granted to the researcher to visit schools for the purpose of conducting interviews with educators responsible for the teaching of natural science (see appendix F).

Permission was sought from the principals and natural science educators of the schools which had been selected as part of the sample. With regard to this, a letter was sent to the principals of these schools (see

appendix D). This letter, together with the list of questions to be asked at the interview (see appendix C), were faxed to the principals of the schools concerned. The researcher then contacted the schools in order to establish a mutually suitable time and date for conducting the interview with the natural science educator concerned.

4.7 The qualitative nature of this research

This research subscribed to the following characteristics of qualitative research that have been identified by Bogdan and Biklen (1992:29-32):

- The researcher collected the data in the natural surroundings of the interviewees. Nine out of the ten educators interviewed, were interviewed at their schools. One educator, at his own request, was interviewed at his home. By visiting the schools and physically collecting the data, the researcher was able to contextualise the interviewees' responses and actions. This enhanced the researcher's understanding of the unique personal and institutional circumstances that influenced the actions and responses of the interviewees.
- By contacting the interviewees telephonically, setting up appointments and conducting interviews, the researcher was able to establish a rapport with the interviewees.
- The researcher assumed the responsibility of collecting the data personally. The researcher, therefore, acted as the primary data collection instrument.
- Data was collected through conducting interviews with natural science educators. The actual verbal communication and descriptive nature of responses were, therefore, crucial in collecting data. The verbal interaction between the researcher and the interviewee, facilitated an understanding of the interviewees' perspectives and the way in which they attached meaning and reason to their actions.
- The data obtained was analysed inductively. The researcher, therefore, did not specifically seek out data to prove or disprove his hypothesis. Data emerged from the interaction between the researcher and the interviewee. This data was then analysed in order to reach conclusions and to establish generalisations.

CHAPTER FIVE

SUMMARY OF INTERVIEWS CONDUCTED WITH EDUCATORS OF NATURAL SCIENCE

5.1 Introduction

This chapter serves to provide details of the interviews conducted with educators of natural science. A general summary of the educators, their schools, their unique personal and institutional circumstances and concerns regarding the environment and environmental education, are discussed in this chapter. The educators' views on natural science and its relationship towards environmental education, as well as their suggestions towards enhancing environmental education, are presented in the following chapter. The data obtained from an interview with each educator, is summarised as follows:

5.2 Interview with the natural science educator at school 1

The interview took place at the educator's school. The interviewee was a female level one educator. A level one educator refers to the lowest level of educator in the South African education system. Such an educator is not part of the management structure of the school. The interviewee is a professionally qualified educator, having completed the four year teacher's diploma at the Bechet College of Education. The subject she specialises in is History and Geography, with Science (Biology) as an ancillary course. The educator has nine years' teaching experience. As a result of internal redeployment within her school, she was given a natural science teaching load for the first time this year. The educator currently teaches natural science to four classes of grade 8 learners. The average number of learners in her classes is 48.

The school is located in the Umgeni South circuit. It is a public school that used to be administered by the former House of Representatives. The majority of the learners at the school speak Zulu as a first language. The medium of instruction at the school is English. The school caters mainly for the medium to lower income groups with the emphasis placed on the lower income groups. The majority of the learners are from the informal settlements. The school buildings are pre-fabricated and the school is situated within close proximity to a light industrial area.

The socio-economic and environmental concerns expressed by the educator included the poverty of the learners, littering, the state of the school buildings, vandalism, pollution and the school's proximity to a light industrial area.

The educator stated that she has not undergone any formal training in environmental education. The educator received neither in-service training, nor attended any workshops with regard to environmental education. The educator was unfamiliar with the acronym 'NEEP,' but succeeded in guessing what it represents.

The educator was unaware of any support structures within her circuit which could assist with the implementation of environmental education. Despite the educator's lack of training in the field of environmental education, the educator demonstrated a reasonable understanding of the concepts 'environment, sustainability in relation to the environment and environmental education.'

The educator believes that the environment is in great danger. She expressed the view that pollution from factories, vehicles and human beings pose the greatest threat to the environment. The educator believes that the natural science learning area has a meaningful role in saving the environment. She expressed the view that the natural science learning area has the potential to provide learners with the necessary knowledge, skills and values which could enable them to lead improved and healthier lives. She views science teaching strategies such as research work, observation and field trips as crucial to saving the environment.

The school does not have a formal environmental policy. A few years ago, an environmental club existed at the school. However, with the departure of the educator, who was responsible for co-ordinating the activities of the club, the club has become defunct. Despite this, the school does appear to engage in environmental activities. However, these activities are limited to campaigns such as Arbor Day. The school has participated in a clean-up campaign (anti-litter campaign) which was organised by the neighbouring primary school. The educator considered these activities as being both co-curricular and extra-curricular. She indicated that an event such as Arbor Day involves the entire school. She expressed the view that such initiatives have been successful and are supported by the various role players at the school.

5.3 Interview with the natural science educator at school 2

The interview took place at the educator's school. The interviewee is a female level one educator. The

interviewee is a professionally qualified educator, having completed a Bachelor of Arts (BA) degree through The University of South Africa (UNISA). She also has a post graduate-diploma, namely a University Diploma in Education (UDE) obtained at the University of Durban Westville (UDW) and a Bachelor of Education Degree (BED) from the University of Natal. Her major subjects are Economics and Education. Her qualifications include science courses, namely Physics 1 and Biology 1. The educator has a total of eighteen years' teaching experience. She has taught physical science right throughout her career as an educator. This is the first year that she teaches natural science. The educator currently teaches natural science both to grade 8 and 9 learners. The average number of learners in her grade 8 classes is 40 and in her grade 9 classes, 43.

The school is located in the Merewent Circuit. It is a public school that was administered by the former House of Delegates. The school has an approximately equal number of English and Zulu speaking learners. The current medium of instruction at the school is English. The school caters for two extreme types of learners, namely the very affluent and the very poor. The school is situated in the heart of one of the most industrialised areas of Durban. It is flanked on either side by two major industrial plants, namely, the Engen Oil Refinery and the Mondi Paper Plant.

The socio-economic and environmental concerns expressed by the educator include the poverty and lack of education of a large segment of the community concerned. The extremely high level of pollution, as a result of the immense industrialisation in the area, is of major concern to the educator. She stated that serious health problems, such as cancer, asthma, bronchitis and other respiratory related problems are common amongst members of the community and that the prevalence of these conditions in the Merewent area could probably be attributed to the industrial activity in the area.

The educator stated that she did not receive any formal training in environmental education. She has not received in-service training of any kind, nor attended any workshop-related environmental education. The educator was unfamiliar with the acronym 'NEEP.' The educator was completely unaware of any support structures within her circuit which could assist with the implementation of environmental education. Although the educator lacks training in the environmental education field, the educator has a fair understanding of the concepts of environment, sustainability in relation to the environment and environmental education. The educator's understanding of these concepts are limited to the biological aspects of environmental education.

The educator regards the environment as being threatened. She expressed the view that industrialisation poses the greatest threat to the environment. She also believes that the natural science learning area has a major role to play in making people aware of the consequences of their actions and in equipping them with the appropriate skills to co-exist in harmony with their fellow beings and with nature. She expressed the view that science teaching should, therefore, encourage the active involvement of learners. Learners should become active participants in the learning process and engage in activities such as research, comparative studies and statistical analyses of the aforementioned studies.

The school does not have a formal environmental policy. Years ago, the school participated in a beach clean-up campaign. The involvement of educators and learners was voluntary, as the clean-up operations were undertaken during week-ends. The campaign was organised by the local rate payers' association and it was successfully conducted for approximately two years. Educators and learners were active participants in this campaign. However, due to a lack of co-ordination, the campaign lost momentum and failed in the year 2000. Ever since, there have been no initiatives initiated by the school, or alternatively support from the school with regard to the environment.

5.4. Interview with the natural science educator at school 3

The interview took place at the educator's school. The interviewee was a female level one educator. The interviewee is a professionally qualified educator, having completed a Bachelor of Science (BSc) Degree at the University of Durban Westville (UDW). She has also completed a Higher Diploma in Education (HDE), which is a one year post-graduate diploma in education, at UDW. The educator's major subjects were Geography and Psychology. As part of her BSc degree, the educator completed a terminal course in Biology, namely Biology 1T. The educator has a total of four years' teaching experience. She has taught Biology throughout her career as an educator. She has been involved in the teaching of natural science for the past two years. The educator currently teaches natural science to two grade 9 classes. The average number of learners in her classes is 37.

The school is located in the Umgeni North Circuit. It is a public school previously administered by the former House of Delegates. The majority of the learners at the school speak Zulu. The medium of instruction at the school is English. The school caters mainly for the lower income groups. The majority of the learners hail from the informal settlements that are located on the periphery of the school. In close proximity to the

school is the Springfield Industrial Park which has both light and heavy industrial plants located in it.

The socio-economic and environmental concerns expressed by the educator, include the degradation of the environment as a result of the many informal settlements that have suddenly emerged around the school grounds. The educator expressed concern about the high levels of pollution in the area as a result of both the informal settlements and the industrial park that surround the school. Litter is a major problem in the area. The informal settlements lack sanitation. As a result of this, many of the learners attending the school do not know how to use the toilet facilities properly and the girls' toilets constantly have blockages due to sanitary towels being flushed down the toilets. Vandalism is a major concern.

The educator stated that she did receive some training in environmental education, as part of her studies in Geography. She has not attended any workshops or received any in-service training in relation to environmental education. The educator was unfamiliar with the acronym NEEP, but she was able to correctly guess what it represents. The educator stated that she is unaware of any support structures that have been established by the KZNDEC to assist with the implementation of environmental education. She is, however, aware of a research centre located in the Springfield Industrial Park which deals with water pollution. The educator demonstrated a reasonable understanding of the concepts 'environment, sustainability in relation to the environment and environmental education.' The educator stressed the biological and social aspects of environmental education.

The educator believes that the environment is under threat. She expressed the view that industrialisation and the emergence of informal settlements pose the greatest threat to the environment. She believes that the natural science learning area has a meaningful role to play in the resolution of these problems, because topics such as pollution, environmental awareness, conservation and ecology could easily be incorporated into natural science lessons. She views science teaching strategies such as field work, excursions to research centres, discussions and debates, as well as the active involvement of learners in campaigns in order to create awareness, as crucial to reversing the degradation of the environment.

The school does not have a formalised environmental policy. A science club exists at the school. Meetings are held approximately twice a month. Attempts have been made to encourage learners to engage in campaigns such as clean-up and anti-litter campaigns, but this has proved not to be very successful. The science club has encouraged a 'greening' of the environment. These activities were all voluntary and extra-

curricular and seem to have failed due to apathy on the part of the learners and the other role players associated with the school.

5.5 Interview with the natural science educator at school 4

The interview took place at the educator's school. The interviewee was a male level one educator. The interviewee is a professionally qualified educator, having completed a three-year diploma in education, namely the 'Junior Secondary Education Diploma' (JSED), at UDW. His subject specialisation is Biology and Physical Science. The educator has a total of sixteen years' teaching experience. He has taught Biology throughout his career as an educator. This is the first year during which he has been involved in the teaching of natural science. The educator currently teaches natural science to grade 8 learners. The average number of learners in his classes is 37.

The school is located in the Umgeni North Circuit. It is a public school administered in the past by the former House of Delegates. The majority of the learners at the school are Zulu speaking. The medium of instruction at the school is English. The majority of learners at the school, do not live in the residential area in which the school is located. The learner population is predominantly from the neighbouring townships and the informal settlements. The school is located in a residential area. A small industrial park which caters for 'light industry,' is located nearby.

The socio-economic and environmental concerns which have been expressed by the educator, include the 'mushrooming' of informal settlements in the area. The educator was concerned about the poor living conditions which prevail in these settlements. These settlements were a major source of pollution in the area and the inhabitants' constant need for fire-wood has been destroying the natural vegetation in the area. The educator expressed concern about the ineffectiveness of the municipality in cleaning up the area and in removing the alien vegetation from the area. He pointed out that the municipality does not actually remove alien vegetation as such, but merely trims it. Additional concern concerns the destructive behaviour displayed by certain elements in the community. An example given by the educator, was the destruction of the school's pond and the killing of the various fish inhabiting the pond.

The educator stated that the neighbouring industrial complex is a minor source of pollution.

The educator stated that he has not received any formal training in environmental education, nor has he received any in-service training related to environmental education. The educator stated that he has attended a workshop in relation to environmental education. This specific workshop was organised by the 'Keep Durban Beautiful Association' and deals with conservation.

He is unaware of any workshops relating to environmental education which have been organised by the KZNDEC. Neither is he aware of any support structures which have been established by the KZNDEC, that could assist with the implementation of environmental education. The school has sent its representative council of learners for a course on conservation to the 'Keep Durban Beautiful Association.' The educator placed emphasis on the biological and social aspects of the concepts of environment, sustainability in relation to the environment and environmental education.

The educator believes that the environment is under threat. He sees the greatest threat to the environment as being the neglect of the surroundings by residents and the municipality. These have resulted in the establishment of informal settlements and poor living conditions for the inhabitants of these settlements. It has also resulted in the invasion of alien vegetation of the area. He believes that the natural science learning area has an important role to play in resolving these issues. Through the teaching and learning of natural science, learners could become aware of the dangers of alien vegetation. It could educate people living in the informal settlements about ways in which to improve their lives and to seek for alternative sources of energy, thereby preventing destruction to the natural vegetation in the area. The educator believes that, for the natural science learning area to be effective, there is a definite need to move away from theoretical discussions and to embrace practical interactions in the environment. Therefore, whatever strategies are used to teach science, they should encourage learners to interact with their environments.

The school does not have a formal environmental policy. However, the school does appear to take environmental issues seriously. The school collects all its waste paper, which it sends to the Mondi Paper Mill for recycling. In return, Mondi provides the school with duplicating paper. Two years ago, the school embarked on a campaign to collect cans for recycling. The school has embarked on clean-up campaigns and enforces a firm anti-litter policy. The school has attempted to remove alien vegetation from its grounds. Learners have also attempted to conduct a water audit. Both of the aforementioned activities have had limited success. Some learners from the school volunteered for a clean-up campaign of the Umhlanga Lagoon. The educator was, however, disappointed that such enthusiasm is not shown for cleaning up their immediate

environment. The educator considered these activities as being both co-curricular and extra-curricular. He expressed the view that these initiatives have received the support of the relevant role players at the school.

5.6 Interview with the natural science educator at school 5

The interview took place at the educator's home. The interviewee was a male level one educator. The interviewee is a professionally qualified educator. His qualifications include a Bachelor of Pedagogic (B Pead Science), obtained from UDW and a Bachelor of Education (BEd), obtained from UNISA. His major subjects are Biology and Education. The educator has a total of eighteen years' teaching experience. He has taught Biology throughout his career as an educator. The educator has been involved in the teaching of natural science for the past three years. He currently teaches natural science to grade 8 learners. The average number of learners in his classes is 34.

The school is located in the Durban Central Circuit. It is a public school, formerly administered by the House of Assembly. The school has an approximately equal number of English and Zulu speaking learners. The medium of instruction at the school is English. The school caters mainly for learners from the more affluent community. The school is situated on the outskirts of the central business district. It is bordered by a shopping complex and commercial and residential buildings. The learners attending the school, are mainly from the Durban area.

While being questioned about the socio-economic and environmental concerns relevant to his school, the educator replied that there were no major problems in this regard. The educator stated that aspects of environmental education have been included in his initial teacher's training. He has not received any in-service training in relation to environmental education. He has attended a workshop relating to environmental education organised by the Wildlife and Environment Society of South Africa. The workshop was held at Treasure Beach in Durban. The educator stated that he is completely unaware of any workshops relating to environmental education organised by the KZNDEC. He is also unaware of any support structures which have been established by the KZNDEC to assist with the implementation of environmental education. The educator was unfamiliar with the acronym 'NEEP.' The educator demonstrated a reasonable understanding of the concepts 'environment, sustainability in relation to the environment and environmental education.' He emphasised the biological and social aspects of these concepts.

The educator believes that the environment is under threat. He regards human beings and their activities as the most serious threat to the environment. He expressed the opinion that the natural science learning area probably has the most important role to play in educating humans to save the environment from further destruction. This is due to the fact that the natural science learning area could effectively utilise the environment as a resource and make reference to environmental issues, as science is about the environment.

The educator believes that there is a need for educators to become innovative in their teaching and to develop strategies which link environmental issues and social values to the classroom situation. He believes that field work, projects and excursions should be encouraged. He expressed the desire for all schools in the area to network amongst one another in relation to environmental education, so that there could be a sharing of ideas and a structured approach towards the implementation of environmental education, for the benefit of all learners.

The school does not have a formal environmental policy. An environmental club, called the 'Outdoor and Wild-Life Club' (OWL) is currently active at the school. During the first term, the club organises an overnight excursion and day field trips are organised at least twice a term. The week prior to this interview having been conducted, the club went on an overnight trip to Ishona Langa Game Reserve. The educator pointed out that all trips have a specific purpose and that on all trips, guides from the venue accompany the learners, so that the maximum benefit may be derived from these trips. The club also organises various campaigns at the school, in keeping with the national calendar. The educator expressed the view that the activities at the school are successful. He regards these activities as being co-curricular activities, which are supported by all role players at the school.

5.7 Interview with the natural science educator at school 6

The interview took place at the educator's school. The interviewee was a female level two educator. She is the appointed Head of Department of Science at this specific school. The interviewee is a professionally qualified educator. Her qualifications include a Bachelor of Pedagogic (B Ped Science), obtained from the UDW and a Bachelor of Education (BEd) obtained from UNISA. Her major subjects are Botany and Education. The educator has a total of sixteen years' teaching experience. She has taught Biology throughout her career as an educator. The educator has taught natural science to grade 8 learners for the first time last year. The average number of learners in her class was 40.

The school is located in the Durban Central Circuit. It is a public school which was in the past administered by the former House of Delegates. The majority of learners at the school speak English as their home language and the medium of instruction at the school is English. The school is located within the CBD of Durban. The school attracts learners right throughout the Durban area. It is bordered by the Technikon, sports grounds, bus and taxi ranks and also commercial buildings. Many of these buildings and the sports grounds, are in a state of disrepair.

The socio-economic and environmental concerns expressed by the educator, included the general state of neglect of the area around the school. The bus and taxi ranks are a source of noise and pollution in the area. Crime, drug use and vandalism are rife in the area. The educator expressed the view that there is a general breakdown of social and cultural values in the area. The area resembles a 'concrete jungle' due to a total lack of greenery in the area.

The educator stated that she has not received any formal training in environmental education. She has also not attended any workshops, or received any in-service training in relation to environmental education. In 1994, her school received booklets on pollution. This is the only material that she has ever received via the education department which she could link to environmental education. The educator was unfamiliar with the acronym 'NEEP' and she is still unaware of any support structures within her circuit that could assist with the implementation of environmental education. Despite the educator's lack of training in the field of environmental education, the educator demonstrated a reasonable understanding of the concepts 'environment, sustainability in relation to the environment and environmental education.' She demonstrated an understanding of these concepts from a biological, cultural and social perspective.

The educator believes that the environment is under threat. She expressed the view that human beings and the commercial activities they engage in, is the main threat to the environment. She identified the bus and taxi industries as a major source of pollution. She also identified street vendors as another source of pollution. She was critical of the municipality and its lack of action in rectifying the state of disrepair in the areas around the school. The educator is of the opinion that the natural science learning area has a major role to play in rectifying these problems. It creates an awareness of the damage that humans cause to the environment and encourages us, as inhabitants of the earth, to care for and manage our resources in a more sustainable way. She identified science teaching strategies such as research, surveys and comparative studies as being suitable to the resolution of these issues.

The school does not have a formalised environmental policy. A club exists at the school. The club meets approximately every second week. The club is actively involved in campaigns such as Arbor Day and clean-ups at the outdoor functions of the school, for example sports events. The educator considers these activities as being co-curricular and as having a moderate degree of success. The various role players at the school are supportive of these activities.

5.8 Interview with the natural science educator at school 7

The interview took place at the educator's school. The interviewee was a female level one educator. The interviewee is a professionally qualified educator. Her qualifications include a Higher Education Diploma (HED), which is a four-year diploma in science, obtained from the Springfield College of Education. Her subject specialisation in this diploma is Zoology and Botany. The educator has a Bachelor of Science (BSc) from UNISA. Her major subjects in this degree, are Botany and Physiology. She also has a BSc Honours Degree in Liminology (water studies) obtained from the Potchefstroom University. The educator is currently completing a Masters' Degree in Marine and Coastal Management at the University of Natal. She has a total of thirteen years' teaching experience. She has taught Biology throughout her career as an educator. She has been involved in the teaching of natural science for the past two years. She currently teaches natural science to two classes of grade 9 learners. The average number of learners in her classes, is 23.

The school is located in the Durban Central Circuit. It is an independent school which was formerly administered by the 'House of Assembly.' The school is an all-female school. The school subscribes to a catholic ethos. The majority of the learners at the school speak English as their home language. The medium of instruction at the school is English. The school caters exclusively for the very affluent and attracts learners from throughout the greater Durban area. The school is situated in an up-market residential area.

The educator stated that in respect of her school, there have been no serious socio-economic and environmental concerns.

The educator stated that environmental education was not included in her initial teacher's training. She has not received any in-service training, nor attended any workshops relating to environmental education organised by the KZNDEC. She was unfamiliar with the acronym 'NEEP' and she was unaware of any support structures within her circuit that could assist with the implementation of environmental education.

The educator has, however, encountered environmental education during her post-graduate studies. This placed the educator in a position to articulate a comprehensive understanding of the concepts of environment, sustainability in relation to the environment and environmental education. She was able to incorporate political, social, cultural, economic biological and ethical dimensions into her understanding of these concepts.

The educator believes that the environment is under threat. She identified human ignorance and a lack of awareness as being the main threat to the environment. She also referred to pollution, urban encroachment and industrialisation as potential threats to the environment. The educator believes that the natural science learning area has a meaningful role to play in resolving these issues, since the natural science learning area exposes learners to ecological and conservation studies. It makes learners more aware of their surroundings and the environmental challenges which we face. The educator expressed the view that the science teaching strategies employed, should create an awareness of the environmental challenges. This could be achieved through field trips, research work, campaigns and classroom discussions of local issues that have relevance for the learners. In this regard, the educator referred to discussions about the levels of pollution in the South Durban Industrial Basin.

The school does not have a formalised environmental policy. However, the catholic ethos which the school subscribes to, does incorporate an awareness of and respect for the environment. The educator is responsible for co-ordinating the activities of the club at the school. The club has embarked on awareness campaigns such as water awareness and pollution awareness. An indigenous garden was created at the school. An attempt is being made to study alien vegetation, in order to be able to identify it and eradicate it. The club's next project is to build a bird bath at the school.

The educator considers these activities as being both co-curricular and extra-curricular. She stated that, as a result of the range of activities included in the curriculum of the school, learners have a wide choice of activities to choose from. As a result, the club attracts a small number of learners (approximately 20 learners). She expressed the view that the school management is extremely supportive of her initiatives in relation to environmental education.

5.9 Interview with the natural science educator at school 8

The interview took place at the educator's school. The interviewee was a female level one educator. The interviewee is a professionally qualified educator, having completed a Lower Secondary Education Diploma (LSED) at the Springfield College of Education. This was a three-year diploma. The educator's subject specialisation is Biology and General Science. The educator has a total of twenty-eight years' teaching experience. She has been involved in the teaching of Biology and General Science throughout her career as an educator. This is the first year that she is teaching natural science. She currently teaches natural science to two classes of grade 9 learners. The average number of learners in her classes is 20.

The school is located in the Umgeni South circuit. It is an independent school which has been established in 1998. The school, therefore, was not administered by any of the former Departments of Education. It is a school for female learners only. The school subscribes to an Islamic religion. In keeping with the Islamic ethos of the school, the entire teaching staff comprises female educators only. Male educators are not allowed to teach at the school. The majority of learners at the school are English speaking. The medium of instruction at the school is English. The school caters for the middle - to upper income groups. All learners at the school are partly subsidised, by the Islamic Education Organisation of South Africa with respect to their school fees. The school has recently moved to a new campus situated on the outskirts of a residential area. Currently, there are no building activities taking place at the school. However, the educator stated that further building activities are planned at the school, but these are dependent upon donor funding from overseas.

The educator stated that, with regard to her school, there are no serious socio-economic concerns. The only environmental concern is the presence of alien vegetation in the vacant area around the school.

The educator stated that she has not received any formal training in environmental education. However, ecological studies did form part of the curriculum of her teachers' diploma. The educator has not attended any workshops, neither has she received any in-service training in relation to environmental education. The educator was not familiar with the acronym 'NEEP' and she was unaware of any support structures within her circuit which could assist effectively with the implementation of environmental education.

The educator's understanding of the concepts 'environment, sustainability in relation to the environment and

environmental education' was limited to the biological aspects of environmental education.

The educator believes that the environment is under threat. She identified humans beings, pollution, urbanisation, deforestation and informal settlements as being the major threats to the environment. The educator expressed the opinion that the natural science learning area could play a significant role in resolving these issues. She stated that natural science could create an awareness of the detrimental effect which human beings could have on the environment by highlighting and learning about activities such as pollution, deforestation and littering. Natural science could also educate learners about the value of indigenous vegetation. It could contribute to the sharpening of learners' skills, such as making observations and predictions and could encourage learners to utilise their senses. She stated that teaching strategies such as field trips and starting a school garden could be useful for learning about the environment.

The school does not have a formalised environmental policy. However, the Islamic ethos which the school subscribes to, does encourage awareness of and respect for the environment. The educator stated that no initiatives have been started at the school to encourage environmental education. She explained that the reasons for this, were that the school only recently moved to their new campus. Further construction work was expected to start at the school soon. Once this construction was completed, a 'greening' of the school campus would be undertaken. The school, also, does not have a perimeter fence. The learners are not allowed to venture outside the school buildings, which are designed in the shape of a quadrangle, for fear of their safety. Once the funding has been obtained and the construction and fencing have been completed, the educator plans to initiate environmental education at the school.

5.10 Interview with the natural science educator at school 9

The interview took place at the educator's school. The interviewee is a female level one educator. The interviewee is a professionally qualified educator, having completed the three-year teachers' diploma at the Durban College of Education. Her subject specialisation is natural science and Business Economics. The educator has a total of two years' teaching experience. This is the first year during which she teaches natural science. The educator currently teaches natural science to three classes of grade 9 learners. The average number of learners in her classes, is 40.

The school is located in the Port Natal Circuit. It is a public school which was formerly administered by the

Department of Education and Training . The majority of learners at the school are Zulu speaking. The medium of instruction at the school is English. The school caters mainly for the middle to lower income groups with the emphasis placed on the lower income groups. The learners at the school derive from the informal settlements and townships right throughout the Durban area.

The school was originally located in the Durban CBD. However, due to the dilapidated state of these buildings, the school was moved to its current location, which was an un-used school of the former HOA. The school is located in a residential area.

The socio-economic and environmental concerns expressed by the educator, include the high rate of unemployment of parents, vandalism and litter. The fact that many of the learners come from homes of single parents and learners originate from all parts of Durban and, therefore, have to depend on public transport to get to school, is a cause for major concern.

The educator stated that environmental education was included as part of the curriculum of her teachers' diploma. She has not received any in-service training or attended any workshops related to environmental education organised by the KZNDEC. She is, currently, part of an environmental project at Zwelibanzi High School in Umlazi, Durban. The Durban College of Education is responsible for the administration of this project and as a former student of the college, the educator has been invited to participate in the project.

The educator was unfamiliar with the acronym 'NEEP'. She was unaware of any support structures that could assist with the implementation of environmental education. The educator's understanding of the concepts 'environment' and 'environmental education' were limited to conservation and conservation studies. The educator was unable to forward any explanation for the concept 'sustainability' in relation to the environment.

The educator believes that the environment is under threat. She expressed the view that industrialisation, illegal dumping of waste and apathy on the part of human beings are the greatest threats to the environment. She expressed the view that the natural science learning area has a meaningful role to play in saving the environment, since the teaching and learning of scientific concepts and principles could develop an awareness of the environment and foster a responsibility for the environment. The educator also expressed the view that natural science could assist learners to understand and control diseases such as HIV and Aids.

She envisages that science teaching strategies such as research, investigations and experimentation are necessary for developing environmental education.

The school does not have a formalised environmental policy. The school attempts to embark on a recycling drive. All learners have been requested to collect at least ten cans each. Once a week, all learners at the school are asked to clear the campus of litter. The school strives to secure a paper bin from the Mondi Paper Mill, so that waste paper could be stored and sent for recycling. It is envisaged that money raised from these recycling projects, could be used to start a vegetable garden at the school and that the crops grown could be utilised to feed the learners at the school. The educator considers these activities as being co-curricular, but she is disappointed that these initiatives have not received the support of the various role players at the school.

5.11 Interview with the natural science educator at school 10

The interview took place at the educator's school. The interviewee was a female level one educator. The interviewee is a professionally qualified educator. Her qualifications include a Higher Education Diploma (HED), which is a four-year diploma obtained from the Springfield College of Education. Her subject specialisation is natural science and Physical Education. The educator is currently completing a Bachelor of Arts (BA) Degree through UNISA. The educator has a total of ten years' teaching experience. She has been involved in the teaching of science for the past nine years. This is the first year during which she actually teaches natural science. She currently teaches natural science to two classes of grade 8 learners and one class of grade 9 learners.

The school is located in the Port Natal circuit. It is a public school which was formerly administered by the 'House of Assembly.' The majority of the learners at the school are Zulu speaking. The medium of instruction at the school is English. The school caters for learners from the middle to upper income groups. The school is situated in a residential area.

The socio-economic and environmental concerns expressed by the educator included apathy on the part of the learners and a lack of knowledge in relation to conservation, waste disposal and the utilisation of the natural resources. The educator stated that litter is a major problem at the school. Learners do not share a sense of communal ownership. There is an invasion of alien plants in the municipal park neighbouring the

school.

The educator stated that she did not receive any formal training in environmental education. She has also not received any in-service training, nor has she attended any workshops related to environmental education which were organised by the KZNDEC. However, the educator has attended workshops that organised by the Wildlife and Environment Society of South Africa. These workshops dealt with topics such as conservation, recycling and subsistence farming. The educator was unfamiliar with the acronym 'NEEP.' She was unaware of any structures set up by the KZNDEC to assist with the implementation of environmental education. The educator stated that she receives guidance and support from the Wildlife and Environmental Society of South Africa in relation to environmental education. The educator demonstrated a comprehensive understanding of the concepts 'environment, sustainability in relation to the environment and environmental education.' She was able to incorporate ecological, social, political, economic, biological and ethical considerations into her understanding of these concepts.

The educator believes that the environment is under threat. She regards human ignorance as being the main threat to the environment. She, therefore, believes that the natural science learning area has a major role to play in saving the environment, as it could assist in creating an awareness of the environment, as well as highlight the detrimental nature that human actions have on the environment.

It could provide learners with the knowledge, skills and values necessary to ensure sustainable life. The educator stated that science-teaching strategies such as excursions, field trips, campaigns and project work are necessary for the natural science learning area to support environmental education.

The school does not have a formalised environmental policy. The interviewee is responsible for co-ordinating the activities of the environmental club at the school. The club appears to be rather active. Members of the club meet and engage in activities for approximately 2 to 3 hours per week. Membership to the club is voluntary and a monthly membership fee of six rand is charged. Some of the activities that the club has engaged in, include an excursion to the society for Care and Rehabilitation of Wildlife (CROW), an excursion to the Ethekwini Waste Water Works which deals with water treatment and water recycling and a clean-up project of the Rossburgh Canal. The club is, also, involved in recycling projects. This includes paper, plastic and glass recycling. A recycling room is available at the school where all material for recycling is kept. Club members have volunteered to assist with the removal of alien vegetation from the neighbouring

municipal park. In addition to the activities of the environmental club, the school enforces a strict anti-litter policy. Every day, a senior and junior class member is put on litter duty to help eradicate the chronic litter problem which the school faces. The educator views these activities as being both extra-curricular and co-curricular and she stated that the various role players at the school are extremely supportive of these activities.

5.12 Summary of chapter

The interviews which have been conducted with the natural science educators, were extremely informative. These interviews were conducted across all five circuits comprising the City of Durban Education District. The peculiarities existing within each circuit and, especially within each school, became evident from interacting with the educators during the interviews. Various factors contribute to the manner and extent to which environmental education is implemented within a school. These factors include the location of a school, the calibre of learners at a school, the qualifications of the educators and their exposure to environmental education, the support of (or the lack thereof) by the various role players involved in education, the motivation of educators and learners and the environmental and socio-economic concerns relevant to the schools. These factors, would, therefore, have a significant influence on the extent to which the natural science learning area could effectively incorporate environmental education.

CHAPTER 6

RECOMMENDATIONS AND CONCLUSIONS OF RESEARCH FINDINGS

6.1 Introduction

This chapter serves to analyse the data obtained from the interviews which have been conducted with natural science educators, within the City of Durban education district. The potential of the natural science learning area, as expressed by the educators themselves, for integrating, supporting and enhancing environmental education and the extent to which this is being successfully achieved, is examined. The factors which stifle the successful entwining of the natural science learning area and environmental education, are now highlighted. Recommendations for overcoming these problems are suggested and conclusions about the relationship between science education and environmental education are formulated.

6.2 The educators interviewed

6.2.1 Analysis of educators interviewed

Ten educators responsible for the teaching of natural science at schools within the City of Durban were interviewed. Eight of these educators were female educators and only two were male educators. All the educators interviewed are professionally qualified educators whom have received some training at least in order to enable them to teach science. Five of the educators have under-graduate qualifications and five possess post-graduate qualifications. In addition to teaching the natural science learning area in the senior phase of the General Education and Training (GET) band. These educators have also been involved in the teaching of other subjects in the school curriculum. Nine of these educators were involved in the teaching of Biology and one educator was involved in the teaching of Physical Science to learners in grades 10, 11 and 12. The teaching of natural science as a learning area within the Outcomes-Based Education (OBE) curriculum, was relatively new to these educators. The reason for this is that, in KwaZulu-Natal (KZN), natural science was firstly introduced to grade 7 learners in the year 2000. It was then extended to grade 8 learners in the year 2001 and only introduced to grade 9 learners in 2002. Of the educators interviewed, seven were teaching this learning area for the first time, two were teaching this

learning area for the second time and only one educator was involved in the teaching of this learning area for the third consecutive year.

6.2.2 Analysis of educator's knowledge and experience in the field of Environmental Education

Only one educator from those interviewed, was able to categorically state that she has been trained in environmental education. This educator was the most recently qualified educator. She graduated only two years ago. One educator stated that certain aspects of environmental education, had been included as part of her studies in Geography. This educator is a recently qualified educator who graduated four years ago. Two other educators stated that environmental education was included as part of their initial teacher's training. However, during the interview, it emerged that these educators misunderstood their studies of ecology and conservation as being synonymous with environmental education. The remaining educators interviewed, stated that environmental education has not been included as part of their initial teachers' training courses. None of the educators had attended any workshops or seminars in relation to environmental education organised by the KwaZulu-Natal Department of Education and Culture (KZNDEC). The educators have also not received any in-service training in environmental education from the KZNDEC. The educators were unaware of any support structures established by the KZNDEC, which could assist with the implementation of environmental education. One educator, by virtue of her post-graduate studies in the science field, has been involved with environmental research.

Despite the lack of initiative on the part of the KZNDEC to provide educators with the necessary training and support structures that are central to the successful implementation of Environmental Education, the initiative taken by certain educators to familiarise themselves with this field of study is commendable. Four of the educators interviewed had, on their own, attended workshops/seminars/ training programmes that were conducted by independent organisations such as the Wildlife and Environmental Society of South Africa and the 'Keep Durban Beautiful' Association. Educators took their learners on structured environmental excursions and in this way increased their knowledge and understanding of the environment and environmental issues.

It was apparent that the educators' knowledge and understanding of environmental education was a function of their initiatives to empower themselves in this field of study. This is in keeping with the views expressed in sub-section 3.5. of this research. Empowerment occurred through furthering their studies, attending environmental courses/workshops, networking with organisations involved with

environmental education and implementing environmental initiatives at their schools and / or within their communities. The educators who were involved in these activities were able to articulate a comprehensive understanding of concepts such as the environment, sustainability in relation to the environment and environmental education. They were able to adopt a multi-faceted view towards the environment and environmental education and did not limit their understanding of these concepts to the biological aspects such as ecological and conservation studies. They demonstrated a holistic view towards environmental education that incorporated the ethical, social, cultural, political and economic concerns. These findings support the views expressed in sub-sections 2.3. and 2.6. of this research. Unfortunately not all educators interviewed possessed such a comprehensive level of understanding and this lack of knowledge on the part of the educators can only negatively influence the successful implementation of environmental education and its entwinement with the natural science learning area.

6.3 Analysis of the state of the environment

All the educators interviewed were unanimous in their view that the environment is being threatened. The educators identified several factors that they considered as being major threats to the environment. Those factors identified by the educators, were largely influenced by the ethos of their schools, the socio-economic issues that were relevant to their schools and the demographics of the area within which their schools were located. One factor that was relevant to all educators was pollution. Educators identified land, air and water pollution as being major threats to our future sustainability. They attributed the main cause of pollution to human behaviour. Humans were responsible for the various types of pollution as a result of industrial activities (both light and heavy industries), vehicle emissions, commercial activities, informal trading, street vending and littering.

Another concern that was expressed by the educators, was the rapid establishment of informal settlements. Educators were concerned that there was no control over the establishment of these informal settlements. The educators were also concerned that these informal settlements lacked basic amenities such as running water and proper sanitation. The squalid living conditions prevalent in these informal settlements were a breeding ground for disease, pollution, criminal activities and a source of degradation to the environment.

Other concerns that were expressed by the educators were the invasion of alien vegetation, deforestation, urban encroachment, diseases, greed, human ignorance and apathy.

The concerns expressed by these educators are similar to the environmental concerns and threats that were highlighted in sub-sections 1.1 and 2.3 of this research. This further emphasises the precarious state of our environment and the threats that this poses to our future sustainability. It is, therefore, incumbent on all educators of natural science to take steps to alleviate this crisis.

6.4 Analysis of science education and its relationship to environmental education

6.4.1 The role that Science Education can play in supporting environmental education

All the educators interviewed were unanimous in their view that the natural science learning area has a major role to play in addressing and rectifying the environmental concerns and threats that were expressed in sub-section 6.3 of this research.

The educators expressed the opinion that the potential of the natural science learning area for effectively addressing the environmental concerns and ensuring sustainable life, derives from the inter-relatedness between science and the environment. The opinions expressed by these educators support the views expressed in sub-sections 2.5 and 3.2 of this research.

The following opinions, were expressed by the educators interviewed

- Science education involves teaching and learning about phenomena that are present in the environment. The environment could, therefore, easily be utilised as a resource in science teaching and learning. In this way, science teaching and learning could create awareness amongst learners of the environmental threats and concerns, as well as the causes of these threats and concerns.
- Science education provides learners with the necessary knowledge, skills, attitudes and values that are necessary to effectively address the concerns that threaten the environment and its future sustainability.

- Science education facilitates the application of scientific concepts, principles and processes to the environment, when seeking solutions to the environmental concerns.
- Science education encourages learners to utilise their senses when engaging in activities such as observing, measuring, predicting and experimenting.
- Science education encourages critical thinking in relation to the environment. This translates into logical action when interacting with the environment.
- Science education inculcates a responsibility for the environment. It makes learners aware of the interdependence between the biotic components of an ecosystem and our dependence on the abiotic components. In this way, it develops a sense of communal ownership of the environment and responsibility towards it.
- Science education creates awareness of diseases and provides us with knowledge to control diseases such as HIV and AIDS.
- Science education encourages learners to engage in research investigations and to further their studies of phenomena that threaten their sustainability. It, therefore, perpetuates scientific study of the environment.

6.4.2 Teaching strategies utilised by educators of natural science to enhance the relationship between science education and environmental education

The educators interviewed stated that the following teaching strategies were being utilised in order to incorporate environmental education into their teaching of the natural science learning area. The teaching strategies which are being used are similar to those strategies suggested in sub-sections 3.4.1 and 3.4.2 of this research. They include the following:

- Setting research assignments for learners with the view towards encouraging supported self-study amongst learners.

- Encouraging learners to become active participants in the learning process through engaging the science process skills such as observing, measuring, inferring, predicting, experimenting, collecting data, interpreting data and presenting data.
- The active involvement of the learners could take several forms such as encouraging and stimulating discussions amongst learners, delivering speeches, participating in debates, presenting alternative views and scenarios and contributing towards the vibrancy and success of the lesson.
- The active involvement of learners in campaigns and awareness programmes.
- Conducting comparative studies and statistical analyses.
- Providing learners with opportunities to experience learning situations outside the classroom. This involves taking learners on field trips and excursions to research centres, game reserves and environmental organisations.
- Conducting environmental audits such as a water audit at the school.
- Relating everyday experiences such as evaporation to the environment.
- Analysis of local environmental issues that have relevance for the learners.
- Participating in recycling programmes.
- Engaging in project work such as building a solar stove to serve as an alternative source of energy.
- Role playing and acting in order to communicate environmental awareness.
- Group work activities such as discussions, project construction or research in order to encourage co-operation between learners.

6.5 Analysis of the initiatives employed by educators of natural science to encourage environmental education

The initiatives employed by the educators of natural science, at schools within the City of Durban and the success that these initiatives have, differ from school to school. The initiatives employed are dependent on the environmental concerns which affect the individual schools. In addition, other factors such as the commitment of the educators and learners to environmental education, the educators' knowledge and experience in the field of environmental education, the support and commitment of the various role players at the individual schools to environmental education and the demographics of the area within which the schools are located, all determine the initiatives which should be used and the extent of their success.

The following initiatives are being employed:

- Active involvement in campaigns such as anti litter and clean up campaigns, Arbor Day and 'water week' programmes. These campaigns are in keeping with the national calendar and are designed to encourage awareness of environmental issues amongst learners.
- The greening of the school campus is being undertaken in certain schools.
- Science Clubs / Environmental Clubs / Outdoor and Wildlife Clubs are active at certain schools. These clubs assume the responsibility of conducting environmentally related activities at the school.
- The removal of alien vegetation from the school campus and surrounding areas.
- Taking learners on environmentally related excursions and on environmental awareness programmes.
- Encouraging biological diversity through activities such as starting indigenous gardens, building ponds and bird baths.
- Participating in recycling programmes.

- Conducting water audits at school.
- Organising activities such as assembly talks, poster competitions and displays.
- Investigating and studying the school environment.

6.6 Analysis of the problems experienced by educators of natural science in implementing environmental education

Some of the problems expressed by the educators are in keeping with the views expressed by Williams in sub-section 3.5 of this research. However, many of the problems expressed by the educators were unique to the South African education system and the educators' personal and institutional circumstances.

The following problems were expressed by the educators interviewed:

- Teaching loads. In addition to teaching natural science, these educators were involved in the teaching of other subjects within the school curriculum. Their duties involved extra-curricular activities, such as sports coaching. Educators, therefore, had little time to become innovative and creative in attempting to incorporate environmental education into science education.
- Time constraints. In addition to the abovementioned problem, educators were concerned with completing their syllabi within the stipulated time frames, so that tests, examinations and other assessments could be timeously completed. Educators, therefore, felt that there was little time to expand on the natural science syllabus and to do justice to the environmental issues and concerns that arose during their teaching.
- OBE. The fact that OBE is new to these educators, coupled with their lack of training in its implementation, is causing problems for educators and affecting its successful implementation in the classroom.

- The lack of pre-service and in-service training of educators in the field of environmental education creates a sense of incompetence amongst educators.
- The lack of a structured syllabus for environmental education leaves educators with no direction of what to do or teach in relation to the environment.
- The absence of support structures by the KZNDEC further negates educators' attempts at successfully combining natural science and environmental education.
- The lack of communication and networking between educators in relation to environmental education.
- Huge learner numbers in the natural science classes.
- Discipline problems experienced at schools.
- Vandalism at schools.
- The lack of resources such as appropriate learning programmes for the implementation of environmental education.
- Apathy on the part of educators, learners, school management, parents and other role players at the schools, prevents a corporate involvement in the establishment of an environmental culture. This task, therefore, becomes the sole responsibility of the natural science educators.
- Communication difficulties as a result of English being the medium of instruction at schools while many learners speak Zulu.
- Transport problems experienced by learners who do not live in the area that the school is located in. As a result, these learners do not participate fully in the extra-curricular activities organised by the school, such as clean up campaigns that are held after school hours.
- Funding and financial constraints experienced by schools and learners.

- Security concerns which prevent educators from taking learners out of the school to engage in environmental activities.
- Environmental clubs having to compete with other extra-curricular and co-curricular activities at the school to attract learners.
- Arrogance on the part of certain learners, which result in their regarding environmental activities such as a clean up as degrading.

6.7 Recommendations and possible solutions to the problems experienced by educators of natural science

The following recommendations are suggested as possible solutions for overcoming the problems experienced by educators:

- Environmental education must become an integral component of the curriculum of all pre-service teacher training courses.
- The KZNDEC should immediately provide in-service training in environmental education to all serving educators.
- Environmental education should be included as a separate learning area within the OBE curriculum. However, one of the educators interviewed was totally against this as she was of the opinion that the curriculum, which already consisted of eight learning areas, was overloaded and could, therefore, not accommodate another learning area. This educator was of the opinion that environmental education could be accommodated within the natural science learning area.
- There must be a structured syllabus for environmental education or at the very least, examples of learning programmes must be made available to all educators in order to facilitate the incorporation of environmental education.

- Specialist educators must be employed at schools to teach and co-ordinate environmental education at schools.
- There must be a decrease in teaching loads of educators and in the teacher pupil ratio's, to facilitate effective teaching and learning in relation to the environment. Reducing the number of learners in natural science classes would create classes with a manageable number of learners. This would encourage more fieldwork being undertaken and create greater interaction with the environment.
- The timetable must be restructured to accommodate environmental education. In this way, all learners at the school will be exposed to environmental education. Even if environmental education is not included as a separate learning area, it can be accommodated on the timetable in the same way that subjects like Right Living and Guidance are accommodated.
- Entire school participation in environmental campaigns and environmental activities must be encouraged. In this way, environmental education becomes the corporate responsibility of all role players at the school.
- The media needs to become pro-active in highlighting environmental concerns.
- There needs to be greater planning, organisation and integration of the eight learning areas in the OBE curriculum.
- Schools must concentrate their efforts on local environmental issues that have relevance to the learners.
- Support structures to facilitate the implementation of environmental education must be established immediately by the KZNDEC.
- Schools within circuits must be encouraged to network with each other in relation to environmental education

- School management must take steps to arrest the slide in discipline and to prevent vandalism at the schools.
- Funds must be made available to encourage environmental activities at the schools.
- Schools must adopt and implement an environmental policy.

6.8 Conclusion

This research set out to examine the role that science education can play in enhancing the delivery of environmental education at South African schools. As environmental education does not exist as an independent learning area in the South African school curriculum, the potential that science education has for educating learners about the environment, in the environment and for the environment, to ensure the sustainability of our world, was examined.

The research began with a clarification of concepts such as environment and environmental education. The emergence of environmental education and its subsequent development in a South African context was discussed. The theoretical underpinnings that facilitate a symbiotic relationship between science education and environmental education were examined. Appropriate science teaching strategies that contribute towards the combining of science education and environmental education, have been suggested and the need for trained educators to practically implement the twining of science education and environmental education was highlighted.

The theoretical discussions were followed by a practical investigation into the state of the relationship between science education and environmental education. This involved the researcher conducting interviews with educators responsible for the teaching of natural science at school within the City of Durban Education District.

In order to conduct this research, the researcher sought permission from the KZNDEC to visit schools for the purpose of conducting interviews. Permission to conduct interviews was also sought from the principals and the natural science educators of the schools selected as part of the sample.

A list of questions that were to be asked at the interview, was drawn up and circulated to all the relevant individuals concerned. A mutually suitable date and time was established between the researcher and the interviewees for the interviews to be conducted.

The interviews proved to be fruitful, as they yielded valuable data on the state of the relationship between science education and environmental education at schools within the City of Durban Education District. The data obtained from the interviews, was initially analysed on an individual basis in recognition of the unique personal and institutional circumstances of the interviewees and the institutions that they serve. This was followed by a general analysis of the data. The analysis of the data led the researcher to conclude that the state of environmental education at schools within the City of Durban Education District, is not ideal. Despite the tremendous potential that science education has for enhancing the delivery of environmental education, there are various factors, as highlighted in sub-section 6.6 of this research, which negate the potential of the natural science learning area for incorporating and enhancing environmental education. Despite the problem, educators are attempting to incorporate environmental education into their teaching of natural science, as highlighted in sub-sections 6.4 and 6.5 of this research. These valiant efforts on their part, cannot go unmentioned. Possible solutions for overcoming the problems experienced are suggested in sub-section 6.7 of this research.

The researcher sincerely hopes that the education authorities take cognisance of the problems experienced with the implementation of environmental education and begin an enactment of the suggested solutions to these problems. Until such time that the education authorities take steps to address these militating factors, the potential of science education for enhancing and implementing environmental education would not be truly realised and the sustainability of our world will continue to be threatened.

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APPENDIX A

C/O Bonela Secondary School
P.O.Box 31037
Mayville
4058

25 March 2002

Dr D W M Edley
Regional Co-ordinator : Research

Sir

Request to conduct interviews with Natural Science (NS) educators within the City of Durban

This letter was originally addressed to Ms B T C Dlamini, who has advised me to redirect it to yourself

I am a student at the University of South Africa (UNISA), currently registered for a Masters Degree in Education, specialising in the Natural Sciences (MEd-Natural Science).

The title of my proposed dissertation is "The Relationship Between Environmental Education And Science Education In The South African Context".

As part of my research, I require to conduct interviews with school based educators, responsible for teaching NS. The purpose of these interviews will be to analyse and to determine the extent to which Science Education has been able to incorporate Environmental Education at School level, and to make suggestions for enhancing the synergy between Science Education and Environmental Education.

I assure you that all information gleaned from these interviews, will be treated confidentially and will be used for academic purposes only.

Permission is hereby requested to carry out the field- work described above.

I attach copies of the following documents:

- A) Proof of student registration
- B) Letter from my supervisor –Professor C.P. Loubser
- C) Questions to be asked at interview

Thank you for your co-operation

Yours faithfully

.....
Satesh Panday

Tel (031) 2616363 (W)
(031) 5782582 (H)
0837777045 (cell)

APPENDIX B

C/O Bonela Secondary School
P.O. Box 31037
Mayville
4058

13 March 2002

DR. D W M Edley
KZN Dept of Education and Culture
North Durban Region

Sir

Request for information relating to the structure of the KZN Dept of Ed Culture

I am a student at the University of South Africa (UNISA), currently registered for a Masters Degree in Education, specialising in the Natural Sciences (MEd-Natural Science).

The title of my proposed dissertation is "The Relationship Between Environmental Education And Science Education In The South African Context".

As part of my research, I require information relating to the structure of the KZN Dept of Ed and Culture, with specific emphasis on the North Durban Region, and the City of Durban in particular. The type of information that I require include maps, graphs, statistical and demographic data.

I assure you that all information gained will be treated confidentially, and will be used for academic purposes only.

Permission is hereby requested to visit the regional offices in order to obtain the information outlined above.

I attach copies of the following documents:

- D) Proof of student registration
- E) Letter from my supervisor-Professor C.P.Loubser

Thank you for your co-operation

Yours faithfully

.....

Salesh Panday

Tel (031) 2616363 (W)
(031) 5782582 (H)
0837777045 (cell)

APPENDIX C

LIST OF QUESTIONS TO BE ASKED DURING INTERVIEWS WITH NATURAL SCIENCE EDUCATORS, IN ORDER TO DETERMINE THE RELATIONSHIP BETWEEN ENVIRONMENTAL EDUCATION (EE) AND SCIENCE EDUCATION (SE)

SECTION A: GENERAL INFORMATION

NOTE: THIS INFORMATION IS REQUIRED FOR CLASSIFICATION PURPOSES ONLY.

THE NAMES OF INDIVIDUAL EDUCATORS AND /OR SCHOOLS WILL NOT BE PUBLISHED.

1. Name of educator. (optional).....
2. Sex of educator.
3. Your professional status at school (eg level 1; Head of Department; Deputy Principal).
.....
4. Your qualifications
 - 4.1 Professional qualification(s) obtained.
.....
 - 4.2 Institution(s) that qualification(s) were obtained from.
.....
 - 4.3 Academic qualification(s) obtained.
.....
 - 4.4 Institution(s) that qualification(s) were obtained from.
.....
 - 4.5 Your highest qualification to teach natural science.
.....
5. Your teaching experience
 - 5.1 Total number of years of teaching experience.
.....
 - 5.2 Total number of years of science teaching experience.
.....
 - 5.3 Total number of years of Natural Science (NS) teaching experience.
.....
- 6.1. Name of your school.
.....
- 6.2. Location of your school.
.....

6.3. Name of the former education department that your school belonged to.

.....

6.4. Is your school a public/ private school?

.....

SECTION B :

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN ENVIRONMENTAL EDUCATION (EE) AND SCIENCE EDUCATION (SE)

1. Which grades are you responsible for teaching NS to?

.....

2. What is the average number of learners in your NS class?

.....

3. State the home language of the majority of your learners.

.....

4. State the medium of instruction at your school.

.....

5. During your initial teacher training course, was EE included as part of the curriculum? (yes/no).....

6.1. Have you received any in-service training in relation to EE? (yes/no)

.....

6.2. Have you attended any workshops / seminars in relation to EE? (yes/no)

.....

7.1. Are you familiar with the acronym NEEP? (yes/no)

.....

7.2. What do you think it stands for?

.....

8. Briefly explain what you understand by the concept ENVIRONMENT.

.....

.....

.....

9. Briefly explain what you understand by the concept SUSTAINABILITY, in relation to the environment.

.....

.....

.....

10. Briefly explain what you understand by the concept EE.

.....
.....
.....

11.1. Briefly describe the socio-economic context of your school.

.....
.....

11.2. List a few socio-economic concerns, relevant to your school, that could have a negative impact on the environment.

.....
.....

12.1. Briefly describe any environmental concern(s) in or around your school.

.....
.....

12.2. In your opinion, is the environment being threatened? (yes/no).....

12.3. If you answered yes above (12.2), who /what do you consider to be the greatest threat to the environment?

.....
.....

13.1. As an educator responsible for teaching NS, do you believe that science can play a role in resolving these issues? (yes /no)

.....

13.2. Briefly explain your answer above.

.....
.....

13.3. If you answered yes above (13.1.), name a few science teaching strategies that you believe could be utilised to resolve these issues.

.....
.....

14.1. Discuss a few activities/initiatives (if any) that have been employed at your school to encourage EE.

.....
.....
.....

14.2. What amount of time was allocated to these activities/initiatives?

.....
.....

14.3. In your opinion, how effective were these activities/initiatives?
.....
.....

14.4. Was your school management/governing body/community, supportive of these initiatives? (yes/no).....

14.5. Would you consider these initiatives as being extracurricular or co-curricular?
.....

14.6. Does your school have an environmental policy? (yes/no).....

14.7. If you answered yes above (14.6.) , please elaborate on the policy at your school.
.....
.....
.....

14.8. Are there support structures/services, available to educators in your circuit, to assist with the implementation of EE? (yes/no).....

15.1. What (if any), are the factors that impede your implementation of EE?
.....
.....
.....

15.2.Suggest possible solutions to overcome these problems
.....
.....

16.1.In your opinion are EE and SE mutually supportive of each other? (yes/no).....

16.2. Elaborate on your answer above
.....
.....
.....
.....

APPENDIX D

C/O Bonela Secondary School
P.O. Box 31037
Mayville
4058

13 March 2002

The Principal

.....
Sir / Madam

Request to conduct an interview with a Natural Science (NS) educator at your School

I am a student at the University of South Africa (UNISA), currently registered for a Masters Degree in Education, specialising in the Natural Sciences (MEd-Natural Science).

I am conducting an investigation entitled "Environmental Education And Its Relationship To Science Education In A South African Context".

As part of my research, I need to conduct interviews with school based educators, within the City of Durban, who are responsible for teaching NS. The purpose of the interview is to determine the extent to which NS educators have been able to incorporate Environmental Education into their teaching of science.

In view of the above, I appeal to you to pardon this intrusion and to allow me approximately 30 minutes of your time, to conduct an interview with an educator teaching NS at your school.

I assure you that all information obtained via the interview, will be treated confidentially and will be used for academic purposes only. Thus no individual school / educator will be singled out in the study.

I have forwarded a copy of the questions to be asked at the interview.

It would be appreciated if you could forward a copy of this request and the questions to be asked at the interview, to the NS educator concerned, and if a mutually suitable date and time could be arranged for me to visit your school to conduct the interview.

Please note that permission to conduct interviews has been obtained from DR D.W. M. Edley- The Regional Co-ordinator :Research, North Durban Region.

Thank you for your co-operation

Yours faithfully

.....

Salesh Panday

Tel (031) 2616363 (W)
(031) 5782582 (H)
0837777045 (cell)

Fax (031) 2614933

APPENDIX E



PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATAL
PROVINSIE KWAZULU-NATAL



DEPARTMENT OF EDUCATION AND CULTURE
UMNYANGO WEMFUNDO NAMASIKO
DEPARTEMENT VAN ONDERWYS EN KULTUUR

NORTH DURBAN REGION ISIFUNDAZWE SENYAKATHO NETHEKU NOORD DURBAN STREEK

Address: Truro House
Ikhehl: 17 Victoria Embankment
Adres: Explanade

Private Bag: Private Bag X54223
IkhWama Sipozi: Durban
Privatelek: 4000

Telephone: (031) 360-6200
Uingo: (Exams Help Desk)
Telefoon: (031) 332-1128
Fax: (031) 332-1128

Enquiries: Dr D W M Edley
Imbuzo: 360-6247
Nayima:

Reference: 2/12/23
Ikhombo:
Verwysing:

Date: 18 March 2002
Usuku:
Datum:

Saresh Panday
C/o The Principal
Bonela Secondary

Fax: 261-4933

Dear Colleague,

PERMISSION TO CONDUCT RESEARCH : VISIT TO NORTH DURBAN REGIONAL OFFICE

1. Your letter dated 13 March 2002 refers.
2. It appears that the kind of information you require would best be obtained through liaison with the the DCES in charge of EMIS, Ms C M Nair.
3. Kindly contact Ms Nair to make arrangements for you to visit her to explain your request in person and hopefully to receive the assistance you require. Ms Nair may be contacted on 031-360-6224. Her office in Truro House is in room 641.
4. Kindly note, that as a serving educator, you may only conduct research outside of normal teaching time.
5. May I take this opportunity to wish you every success in your research.

Yours faithfully,

Dr D W M Edley
Regional Co-ordinator: Research
For REGIONAL CHIEF DIRECTOR

cc. Ms C M Nair

APPENDIX F



PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATAL
PROVINSIE KWAZULU-NATAL



DEPARTMENT OF EDUCATION AND CULTURE
UMIN'YANGO WEMHUNDO NAMASIKO
DEPARTMENT VAN ONDERWYS EN KULTUUR

NORTH DURBAN REGION		ISIFUNDAZWE SENYAKATHO NETHEKU		NOORD DURBAN STREEK	
Address:	Truro House	Private Bag:	Private Bag X54323	Telephone:	(031) 380-6269
Ikhehl:	17 Victoria Embankment	Isikhweima Beposi:	Durban	Udingo:	(Exams Help Desk)
Adres:	Esplanade	Privaatleë:	4000	Telefoon:	
				Fax:	(031) 332-1126
Enquiries:	Dr D W M Edley	Reference:	2/12/23	Date:	26 March 2002
Imbuzo:	360-6247	Inkomba:		Usuku:	
Naves:		Verwysing:		Datum:	

Mr S Panday
Bonela Secondary

Fax: 261-4933

Dear Mr Panday,

PERMISSION TO CONDUCT RESEARCH : NORTH DURBAN REGION

1. Your letter dated 25 March 2002 refers.
2. You are hereby granted permission to conduct research in Schools in the North Durban Region, as set out in your letter of application. The permission is subject to the following conditions:
 - a. No school/person may be forced to participate in the study;
 - b. Access to the schools you wish to utilise is to be negotiated with the principals concerned by yourself;
 - c. The normal teaching and learning programme of the schools is not to be disrupted;
 - d. The confidentiality of the participants is respected; and
 - e. A copy of your research findings must be lodged with the Regional Chief Director, upon completion of your studies.
 - f. You accept that as a serving educator in the employ of the KZNDEC, teaching time will not be used for research purposes.
3. This letter may be used to gain access to the schools concerned.
4. May I take this opportunity to wish you every success in your research.

Yours faithfully,

Dr D W M Edley
Regional Co-ordinator: Research
For REGIONAL CHIEF DIRECTOR